AN INTEGRATED PRACTICE OF MEDICINE

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A Complete General Practice of Medicine From Differential Diagnosis by Presenting Symptoms to Specific Management of the Patient

By HAROLD THOMAS HYMAN M D

1184 Illustrations 305 in Color
319 Differential Diagnostic Tables

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SECTION XIII

THE RESPIRATORY SYSTEM

Associate Editor LEONARD BASES M D

INTRODUCTION METHODS OF DIAGNOSIS AND TREATMENT

The respiratory system consists of the structures of the nose and the para nasal sinuses the pharynx and its lymphoid rings including pharyngeal and lingual tonsils the eustachian tube leading to the middle ear larynx trachea and bronchi pulmonary parenchyma pleural membranes thoracic cage and pleural cavities diaphragm and mediastinum Included with the pre ent material are considerations of the auditory apparatus which is phylogenetically embryologically and anatomically related to the structures of respiration In most communities a single specialist the otorhinolaryngologist acts as consultant for ear no e and throat disturbances

ANATOMIC REVIEW

Nose (p 3 88)
Paranasal Sinuses (p 3 93)
Pharynx (p 3 99)
Larynx (p 3604)
Trachea and Bronchi (p 2094)
Thoracic Wall (p 3 22)
Thoracic Cavity and its Contents (p 3)
Ear and Organs of Hearing (p 3610)

PHYSIOLOGY

The physiology of the respirat y system is concerned with stu l es of gaseous interchanges between t sues circulating blood al eolar and atmosph ric air

Internal Resp rat —In the pro ess of internal respiration circulatin blood yields oxygen to and rece ves carbon dioxide from the ti sues the latter receive oxygen from and yiel l carbon dioxide to the bloo l Hemoglobin functions for the sto a e and transportation of oxygen while sodium bicarbonate serves correspondingly for carbon d ox de

Oxygen and carbon d ox le tran po tation and d ssociation are lependent upon and productive of alterat or s in tl e acid ba e relat onsh p of circulat ng blood The medullary center esponds del cately to cl an es in blood cl emist y Acidos s hypercapn a and anoxemia produce hyperpnea while hype pnea results in alkalosis

Neurogenic Control—Respir t on is controlled tl rough a physiologic center which is tuated in th medulla The important p ripheral pathways are the vagus and phrenic nerves The respirato y center may b affected by voluntary control by reflex stimulat on of per ipheral afferents as in the inh l tion of resp rat on due to pain by stimulat on of nerve endings in the per phery of the lungs (H ring Breue eflex) by central pharmacodynamic action as the medullary depre sion caused by morphine by alterat ons in the vascularity of the medullary capillaries such as are responsible for periodic breathing (Cheyne Stokes) and by stimulat on of cl emorec pto s in carot d sinus and in medulla

E te l Resp tion—The external respiratory passages e tend from nares to pulmonary alveoli and capillaries Here the e occurs an interchange of gases between atmospheric air and air n the lungs atmosphe ic air yields oxygen and r c ves carbon dioxide whereas air in lungs eceives o ygen and yields c rbon d ox de

E ternal resp rat on is automat cally controlled throu h the respiratory center The phys co hem cal c reulatory and humoral factors that control external resp ration initiate in the m dbra n As a res lt a se ies of mpulses pas es through phre ic nerve to diaphragm and through divers other patl ways to external resp rato y muscles The thoracic cage is *fixed by certain of the external muscles the diaphragm produces vertical* enlargement of the tl o acic cavity by its downward pull and external respiratory muscles raise and widen the cage thr ugh their act n on the lower rib Duri g increase of the diameter of the thoracic cage the l ngs are actively expand l through incr sed negativity of intrapleural p essure atmospl er c air ru l es in through the airw ay and interchange of gases occurs in the a r spac s oxyg n is onsumed carbon lioxid is blown off and the neurochemical

Following maximum expiratory effort there remains a residual content of air that approximates 1000 to 1500 cc This is present in the lungs after death and is responsible for their buoyancy

METHODS OF EXAMINATION

Routine examination of the respiratory organs furnishes valuable information to the practitioner The upper air passages are inspected directly and by artificial illumination particularly in the dark room (p 3088) anterior rhinoscopy transillumination of the sinuses mirror laryngoscopy myringoscopy and gross tests for acuity of hearing are performed The chest wall is inspected palpated percussed and auscultated in the investigation of intrathoracic disorders (p 3532)

Laboratory Aids

Accurate diagnosis affording definite indications for therapeutic procedures is nowhere more necessary than in respiratory disease Bacteriologic smears and cultures are essential to the identification of etiologic organisms Sputum pus exudates and pleural fluids are stained inoculated on special media or injected into mice or guinea pigs and allergy tests are indicated in afflictions due to sensitization Radiography clarifies or reveals lesions in nasal accessory sinuses mastoid processes and chest when routine roentgenography is inconclusive contrast films are taken after instillations of radiopaque material into sinuses or bronchi

Specialist Investigation

For more exacting diagnostic procedures the practitioner consults otologist or rhinolaryngologist

THE OTOLOGIST

Otological consultations are required under the following conditions

1 The presence of an *otitis media* of more than the mildest severity (p 2144)
2 A persistent *otitis externa* (p 2150)
3 For the investigation of a *chronic aural discharge* (p 2150)
4 On suspicion of a complication in the *mastoid cells* or within the cranium secondary to *middle ear infection* (p 2145)
5 For *catheterization of the Eustachian tube* (p 2015)
6 More accurate tests for *acuity of hearing* (p 2015)
7 The investigation of *tinnitus aurium* (p 2141)
8 The conduct of *labyrinthine* and *vestibular tests* (p 2018)

Catheterization of the Eustachian Orifices—The eustachian orifices are catheterized by a silver eustachian tube cannula introduced along the floor of the nose until the nasopharynx is entered The ear can be insufflated through the eustachian tube The presence of strictures can be determined and the expert is enabled to dilate these with the skilful use of wax bougies

Acuity of Hearing—Gross testing for the acuity of hearing can be done by estimating the distance at which the whispered voice or the tick of a watch may be heard in either and both ears The examiner is used as a control subject

mechanisms of expiration are prepared In the course of the latter the diameter of the thoracic cage is narrowed through passive relaxation of contracting muscles the lungs deflate through their own elastic recoil and tidal air is expired through the nares

The Respiratory Cycle—The normal adult respires at a rate of 15 to 20 per minute The respiratory rate is usually more rapid in infants and children Under pathological conditions the rate may be as low as 2 to the minute (as in morphine poisoning) or as rapid as 100 to the minute

Pulmonary Air—The air within the pulmonary tree consists of several different elements *Tidal air* which is the amount that passes in and out in ordinary respiration ap-

DIFFERENTIAL DIAGNOSIS OF

Bradypnea, Oligopnea and Apnea

Disturbances of re piration on the side of depres ion include bradypnea which represents a simple decrease in the depth of respiration, oligopnea or a fall in the respiratory rate and apnea in which there is cessation of re piration

Diminution in the rate of respiration may be so well compensated by increase in depth that a minute rate of 6 to 8 is compatible with adequate respiratory and circulatory function Further reduction in the rate of re piration however or cessation of respiration for more than a few seconds results in asphyxia and imminent fatality unless prompt and effectual treatment is instituted

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Psychogenic	Breath holding in infancy
Pharmacodynamic	Hypersen itivity to or overdosage with opiates barbiturates hypnotics sedatives and general anesthetics (p 3853) Pin point pupils with opiates but mydriasis with other drugs If no history of drug administration, suspect poisoning
Metabolic	Renal insufficiency with a otemia (p 2277) Diabetic coma with ketosis and hyperglycemia (p 1257) Continued operation of causes produces initial hyperpnea and dyspnea (p 2016) Try inhalations of oxygen containing 5 to 10 per cent carbon dioxide (p 3827)
Neurogenic	With advance of medullary depression in organic disturbances productive of hyperpnea and dyspnea (p 2016) Supplement neurologic examination with inspection of fundus and consider collection of cerebrospinal fluid (p 3734)
Autonomic	Hyperactivity of carotid sinus with as ociated syncope (p 922) Note sensitivity to digital pressure

proximates one eighth of total capacity and is usually equivalent to 500 cc *Complemental air* is the amount that can be drawn in after ordinary expiration and measures about 3000 cc including the tidal air *Supplemental air* is the amount that can be exhaled after ordinary expiration and is about 1000 cc Supplemental air is analogous to *reserve air* The total of complemental and supplemental air is *vital capacity* which is the total amount that can be exhaled after a maximum inspiration Vital capacity is capable of clinical measurements (p 3739) it approximates 2 6 liters per square meter in the male and 2.07 per square meter in the female For the adult of ordinary size it varies between 3000 and 4500 cc with very slight variations according to age barometric pressure and room temperature

Circulatory	Acute and chronic pericarditis angina pectoris coronary insufficiency coronary thrombosis forward and backward failure paroxysmal cardiac irregularities aortitis aortic aneurysm, hypertension of lesser circulation, arteriosclerosis of pulmonary artery arteriovenous aneurysm and congenital cardiac disorders Supplement physical examination with Ecg and chest x ray Consider oxygen therapy and administration of quinidine (p 861) or digitalis (p 854)
Hematologic	Moderate to severe anemias and polycythemia Get hemogram (p 3704) Note effects of hematinics or indicated phlebotomy (p 852)
Defects of Thoracic Cage	Fixation with diminished motility and barrel chest in emphysema (p 2066) Muscle paralysis with atrophy in poliomyelitis hemiplegia and muscle dystrophies.
Diaphragmatic	Elevation resulting from tympanites ascites pregnancy and large abdominal tumors Phrenic nerve paralysis and diaphragmatic flutter observed by fluoroscopy
Respiratory	Obstruction of airway diminution of respiratory surface area with congenital anomalies mechanical and chemical injuries and neoplasms vascular neurogenic and local metabolic disorders allergy and infection. Supplement physical examination with sputum survey (p 3719) rhinoscopy (p 2021) laryngoscopy (p 2024) bronchoscopy (p 2026) chest radiography (p 3740) bronchography (p 2061) examination of pleural fluid (p 2030) or biopsy

The use of a tuning fork in the testing of hearing gives more accurate information The range of hearing is tested by using forks of low and high frequencies since many individuals have a differential type of deafness

Weber Test—The Weber test gives a lateralization of the hearing defect The fork is placed in the median line of the skull where under normal circumstances the patient reports that the sound is heard inside the skull A lateralization to one or the other side is abnormal (p 2019)

Rinne Test—The Rinne test compares sound conduction by air and by bone To perform the test a tuning fork is struck and the duration of the perception of sound is measured when the fork is placed (1) on the mastoid tip and (2) just beyond the external auditory meatus The normal positive Rinne is present when bone conduction approximates half of air conduction time The abnormal or negative Rinne is noted when bone conduction equals or exceeds air conduction time

Audiometer—The audiometer by which hearing tests have achieved perfection accurately charts the entire range of hearing It permits hearing aids to be accurately measured and their efficacy to be evaluated Audiometers are expensive but it is well worth the expenditure of time energy and money for the patient to visit a specialist provided with this equipment since the solution of the handicap of bad hearing means a great deal in the life of any deafened individual (p 2019)

DIFFERENTIAL DIAGNOSIS OF

Hyperpnea, Tachypnea, Polypnea, Dyspnea, Orthopnea, and Respiratory Irregularities

Disturbances may be observed in the rate depth rhythmicity and consciousness of respiration On the side of stimulation the earliest change consists of hyperpnea in which there is a simple increase in the depth of respiration. The terms polypnea and tachypnea refer to increased respiratory rate without necessary change in depth Dyspnea is the conscious ness for the necessity of increased respiratory effort and orthopnea is the irresistible desire to assume a sitting or semirecumbent position in order to assist in the achievement of respiratory effort Hyperpnea tachypnea and polypnea are respiratory disturbances that rarely give rise to clinical problems but shortness of breath is a complaint that requires investigation and orthopnea is encountered in severe cardiopulmonary difficulties

The respiratory irregularities vary in their significance from the sighing and breath catching of psychogenic origin to the grave disturbances described by Biot and Cheyne Stokes Biot breathing is an irregular irregularity and the Cheyne Stokes type is a periodic disturbance in which episodes of apnea are interspersed with phases of crescendo and decrescendo respirations

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	Hyperpnea of effort induced more easily and is more persistent with diminution in cardiac reserve and flabbiness of skeletal musculature Increased or decreased atmospheric pressures as in altitude sickness and caisson disease Fever or increase in B M R
Psychogenic	Polypnea hyperpnea sighing yawning and inability to catch breath due to emotion anxiety neuroses and hysteria
Neurogenic	Cheyne Stokes and Biot irregularities from vascular and metabolic disturbances of respiratory center Associated with increased intracranial pressure backward failure uremia bulbar palsy and all types of asphyxia Note effects of oxygen therapy (p 3827)
Autonomic	Paroxysmal and especially nocturnal hyperpnea often with terror dreams from carotid sinus stimulation in hypertension and aortitis Disturbance of autonomic control of respiration (Hering Breuer reflex) with emphysema bronchial asthma pulmonary fibrosis and miliary carcinomatosis Supplement physical examination with chest x ray Note therapeutic response to epinephrine in bronchospasm (p 2101)
Chemical and Metabolic	Anoxemia hypercapnia acidosis uremia methemoglobinemia sulfhemoglobinemia and carbon monoxide hemoglobinemia Examine urine for ketone bodies and glucose (p 3567) Get blood chemistry for sugar and urea (p 3712) Order spectroscopic examination of blood (p 3692) Note effects of oxygen therapy (p 3827)

CONTINUED

DIFFERENTIAL DIAGNOSIS OF

Diminution in the Acuity of Hearing and Deafness

Diminution in the acuity of hearing may be caused by lesions of peripheral structures such as the external auditory canal ear drum or eustachian apparatus It may result also from less readily detectable disturbances of the internal ear labyrinth, eighth cranial nerve or path ways of the center for hearing in the temporal lobe The Rinne and Weber tests which require only the use of a tuning fork assist the practitioner in differentiating conduction and nerve deafness With the Rinne test (p. 2017) the results are negative (bone conduction exceeds air conduction) in the conduction variety whereas the positive test prevails in nerve deafness (air conduction vastly exceeds bone conduction) In the Weber test (p 2017) lateralization is toward the deafened ear with a conduction defect, whereas the sound is heard better in the normal ear when there is unilateral nerve deafness

The handicap of deafness is so great and the nature of the investigation so complex that the practitioner is required to refer his patient to the otologist for a complete survey including audiometry and for specialist treatment and the prescription of a hearing aid

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	Senility Noisy industries Aviation and war combat
Psychogenic	Hysteria and malingering
Congenital Anomalies	Absence of ear or deaf mutism (p 2045)
Mechanical Disturbances	Foreign body cerumen, osteoma cholesteatoma stricture or stenosis of external auditory canal or perforation of drum as detected by otoscopy (p 3609) Obstruction to eustachian tube or canal by adenoids juvenile fibroma or lympho-epithelioma of nasopharynx Stricture stenosis discharge crusting or collapse due to increased atmospheric pressure Refer to specialist for posterior rhinoscopy and catheterization of eustachian tubes
Systemic Infection	Measles and scarlet fever with characteristic rashes Mumps with parotitis Meningitis and encephalitis with other neurologic signs and changes in the cerebrospinal fluid (p 3734) Syphilis with positive serology in blood or spinal fluid (p 3736)
Local Infection	Acute myringitis with bulla of drum (p 2143) Acute and chronic otitis media mastoiditis labyrinthitis or petrositis with visible otoscopic changes and evidences of clouding or bone destruction by x ray (p 3740) Refer to specialist
Metabolic and Toxic Causes	Otosclerosis with normal drums and eustachian tubes Acoustic neuritis due to quinine salicylate arsenic nicotine alcohol or mercury
Neurogenic	Fracture of base of skull with history of trauma and x ray changes Tumor of cerebellopontine angle or temporal lobe with other neurologic manifestations Neuritis of 8th cranial nerve due to syphilis or trauma Get skull x ray (p 3740) and Wassermann tests of blood and spinal fluid (p 337)
Vascular	Hemorrhage into labyrinth with vestibular manifestations Profound anemia with characteristic hemogram (p 3704)

Vestibular Examination by Caloric Rotation and Galvanic Tests—The vestibular examination consists of a caloric rotation and galvanic test The first two indicate altered currents in the endolymph of the semi circular canals The galvanic test relies on direct stimulation of the ves tibular nerve fibers

For the *caloric test* the patient is seated in a chair and the external auditory canal is irrigated with cold (20° C) or hot (50° C) water which flows slowly until one or two quarts have been used With head tilted forward the vertical canals are tested Later with the patient lying with his head back the horizontal canals are tested Each ear is investigated separately After the irrigation the patient opens his eyes and directly gazes first to one side and then to the other The examiner notes the pres ence and duration of *nystagmus* as well as the tendency of the patient to fall

The *rotation test* is performed with the patient seated in a revolving chair The head is placed on a specially constructed head rest With the

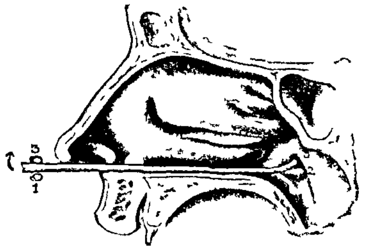


Fig 453—Catheterization of the right eustachian tube

patient upright and head tilted forward the horizontal canals are tested For investigation of the vertical canal the head is bent forward almost to a right angle with the body The chair is rotated ten times in quick succes sion and then brought to a sudden stop The eyes are examined for the appearance and persistence of nystagmus

The *galvanic test* is carried out with the patient standing feet to gether and eyes closed The cathode is held in one hand and the anode is applied in front or in back of the ear If the vestibular nerve is normal there is a tendency to postural deviation to the side of the anode reversing the current the deviation is to the opposite side A current of 5 milli amperes is used Failure to elicit a response signifies a dead nerve The necessity to raise the milliamperage up to 15 or 20 means definite inter ference with conduction A lively response to as little as 1 or 2 amperes denotes hyperirritability

The *interpretation* of these tests is the province of the expert

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Systemic Infection	Toxic labyrinthitis due to influenza herpes mumps, measles scarlet fever diphtheria meningitis virus infections and serum injections Note eruption Check cerebrospinal fluid (p 3734)

THE RHINOLARYNGOLOGIST

The rhinolaryngologist is consulted for diagnostic investigation under the following circumstances

1 Confirmation of an *abnormal finding* in the nose and throat

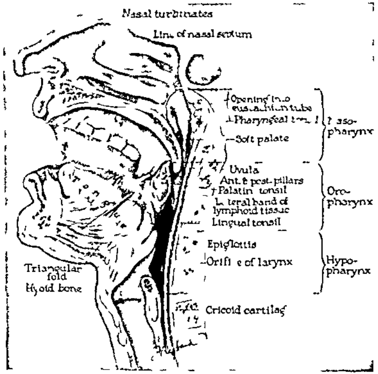


Fig 454—Sagittal section showing outer wall of the right nasal cavity nasopharynx palate pharynx and larynx

2 Search for *focal infection* (p 42)
3 *Posterior rhinoscopy* (p 2021)
4 *Lavage* of the *maxillary sinuses sphenoids and frontals* (p 2023)
5 *Direct laryngoscopy* (p 2025) especially with ulceration or a suspected neoplasm Specimens obtained are subjected to darkfield and histologic examination in addition to the routine investigation
6 *Per oral bronchoscopy* (p 2034) *esophagoscopy* and *gastroscopy* (p 1745)

Posterior Rhinoscopy —Examination of the nasopharynx and the posterior choanae is accomplished with the help of the postnasal mirror tilted

Shambaugh Jr in Jackson and Jackson Diseases of the Ear Nose and Throat.

DIFFERENTIAL DIAGNOSIS OF

Vertigo

Vertigo giddiness or dizziness is an extremely complex symptom involving peripheral stimuli through eye and ear as well as anatomic toxic and metabolic disturbances of labyrinth and central nervous system Fortunately disturbances causing dizziness are usually transitory and remediable If however the discomfort persists or recurs with frequency and increased intensity an extensive investigation is required, enlisting the services of otologist, ophthalmologist and neuropsychiatrist

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Mechanical	Seasickness or car sickness. Caloric or rotary stimulation (p 2018) Sunstroke and concussion. Increased and decreased atmospheric pressure Gastrovisceroptosis and orthostatic hypotension. Note blood pressures recumbent and erect. Try effects of abdominal binder
Toxic and Metabolic	Acute alcoholism or gluttony Overdosage with sedative salicylate hypnotic quinine opiate tobacco and caffeine Persistent nausea and vomiting with dehydration Anoxemia Carbon monoxide poisoning
Otogenic	Acute and chronic mastoiditis labyrinthitis and petrositis with deafness and x ray changes Otosclerosis Obstruction of external auditory canal with foreign bodies water or cerumen Obstruction of eustachian tube Refer to otologist
Ocular	Eyestrain, diplopia nystagmus and ocular imbalance Acute glaucoma with increased intraocular tension Refer to ophthalmologist
Neurogenic	Cerebral anemia thrombosis and embolism Tumors of cerebrum, cerebellum and cerebellopontine angle Tabes and other neurosyphilitic manifestations with positive Wassermann Encephalitis and meningitis with characteristic changes in cerebrospinal fluid Multiple sclerosis Following lumbar puncture and spinal or caudal anesthesia In the migrainous attack with hemicrania Meniere s syndrome with nystagmus Refer to neurologist
Psychogenic	Neuroses and hysteria
Vascular	Generalized arteriosclerosis Hypertension Postural hypotension. Acute hypotension as in the crises of Addison s disease Forward and backward failure Onset of paroxysmal cardiac irregularity Hypersensitivity of carotid sinus Following acute hemorrhage Supplement physical examination with fundus examination, (p 3629) Ecg (p 803) and chest film (p 3740)
Hemic	Anemia and polycythemia Get hemogram (p 3704)

permit direct visualization of the mucosa of the epipharynx The Yankauer boot is introduced below and behind the uvula with the head in marked dorsi extension The mucosa can be thoroughly inspected and a biopsy taken with a punch forceps

The *electric nasopharyngoscope* affords little more information than a properly executed posterior rhinoscopy

Lavage of the Accessory Nasal Sinuses—The maxillary antra the sphenoid and frontal sinuses are accessible to intranasal lavage

Irrigation of the maxillary sinuses through the natural orifice can be effected in the large majority of cases by the use of the Yankauer middle-meatus cannula or the Pierce antrum cannula After thorough anesthetization of the middle meatus the cannula is introduced upward and back

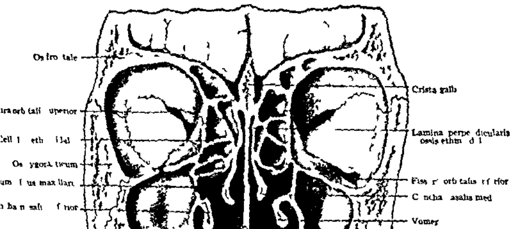


Fig 456.—Frontal section through the brain orbits paranasal sinuses and nasal fossae to show their interrelations*

ward If difficulty is encountered it may be possible to enter the antrum through the accessory natural orifices or an artificial opening can be made by puncture through the inferior meatus During antral lavage the patient usually complains of pain and pressure referred to the upper teeth

Sphenoid irrigation is accomplished by passing of Yankauer sphenoidal cannula or an Andrews curved cannula into the spheno ethmoidal recess The tip of the cannula is then rotated lightly laterally at which point the phenoid will be entered The Yankauer cannula contains markings at 7 7.5 and 8 cm The anterior wall of the sphenoid is usually found in the male at 7 cm With the cannula introduced to 7.5 cm the lumen of the sphenoid sinus has been certainly entered and lavage is begun The

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at a 45 degree angle to the shaft and introduced into the oropharynx behind the uvula The patient is instructed to breathe through his nose or to sniff as if he were smelling in order to depress the uvula and permit a thorough investigation of the nasopharynx

The rostrum can be seen between the two posterior choanae The posterior tips of the middle and inferior turbinates may be visualized and pathologic changes such as polypoid degeneration and hypertrophy are noted Purulent secretion may often be seen in the posterior choanae and

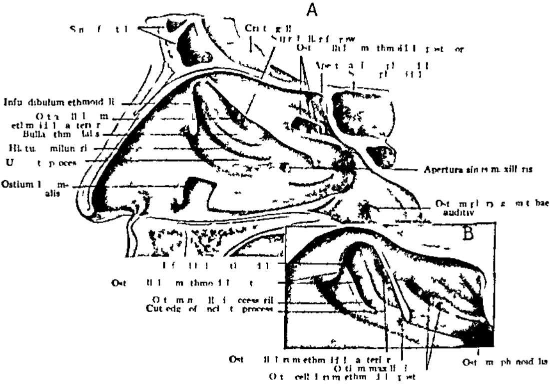


Fig 455—Lateral wall of the right nasal fossa with parts of the turbinates removed to show diagrammatically the openings into the paranasal sinuses

In *A* portions of the superior middle and inferior turbinates have been removed the openings into the frontal and ethmoid sinuses are strictly diagrammatic as they are too small to locate accurately

In *B* the anterior portion of the middle turbinate is removed to show the sinus openings in the semilunar hiatus of the middle meatus part of the uncinate process has been cut away *

above the middle turbinate in posterior *ethmoiditis* and *sphenoiditis* (p 2124)

The eustachian tube is noted on the lateral wall Secretion is often encountered in the fossa of Rosenmueller above and behind the posterior lip of the eustachian orifice Adenoid tissue and Thornwaldt s abscesses are sometimes encountered in the vault A small growth or neoplasm in the nasopharynx can be visualized In instances where a neoplasm is suspected the introduction of a Yankauer nasopharyngoscope or boot will

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Technic of Peroral Endoscopy—The introduction of the direct laryngoscope and bronchoscope requires special training and proper equipment including a complete endoscopic outfit When skilfully introduced the presence of the metal tube in the air passages entails little risk except in infants where mechanical obstructions may result after bronchoscopy The endoscopist should be trained beyond the mere technic of the introduction of the laryngoscope and bronchoscope He must learn to judge the depth of objects from the tube by monocular vision While direct laryngoscopy reveals little more than the observations made by the practitioner who does mirror or indirect laryngoscopy the specialist method permits the removal of foreign bodies and the taking of biopsies from suspected neoplasms

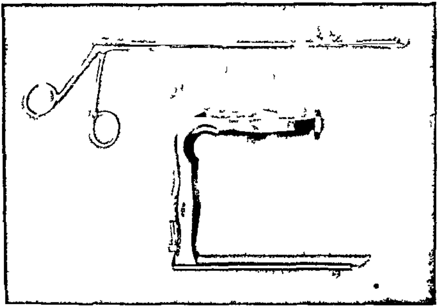


Fig 457—Direct laryngoscope of smooth tipped anterior commissure type and angular cupped forceps

For endoscopy the patient should be prepared by thorough cleansing of the mouth and removal of all loose teeth and removable dentures No food should be taken for six hours prior to the procedure and morphine 0 015 gm (¼ grain) and atropine 0 001 (1/60 grain) should be administered fifteen minutes before the adult patient is sent to the operating room

Examination on an endoscopic table and proper positioning are essential for the success and safety of direct visual examinations The head is supported by a trained assistant The patient lies on his back with the middle of the scapula over the free end of the table The aim is to secure the best position for the introduction into the airway of a straight rigid tube

DIRECT LARYNGOSCOPY —Direct laryngoscopy usually can be performed

patient leans forward and opens his mouth so that the irrigating fluid does not enter the eustachian tube If the natural opening of the sphenoid can not be entered the sphenoid sinus is punctured through its anterior wall or the posterior portion of the middle turbinate is removed and the irrigation is performed through the natural orifice under direct vision

After the lumen of the sinus has been entered by whatever method the sinus is irrigated with a warm saline solution entering under pressure of 15 to 20 pounds Air under pressure is introduced with the saline solution to dislodge exudate in the sinal cavity and promote proper lavage The air should not be used unless the fluid is flowing freely for fear of inducing an air embolism During irrigation of the sphenoid and especially when the air is introduced the patient usually complains of pain and pressure referred to the occiput and nape of the neck

The *frontal sinus* is best irrigated through the frontonasal canal although considerable difficulty may be encountered in this procedure The ostium of one of the anterior ethmoidal cells may be entered rather than the frontal sinus or the middle turbinate may be hypertrophied and in contact with the lateral nasal wall so that introduction of the cannula is difficult Under these conditions it is possible to retract the middle turbinate medially and then introduce the catheter In any event the removal of the anterior portion of the middle turbinate overcomes any difficulty and renders possible irrigation of the frontal sinus

During the lavage the patient may complain of pain and pressure over the eyes and across the forehead

Per oral Laryngoscopy and Bronchoscopy—Per-oral endoscopy allows the examination of the interior of the larynx trachea and bronchi by use of special specula permitting direct visualization

Anatomic Review—The *larynx* has been elsewhere described (p 3601)

The *trachea* is a wide tube beginning at the lower border of the cricoid cartilage and ending at the bifurcation at the superior border of the fifth thoracic vertebra It varies in *length from 4 to 5 inches It is kept patent by dense cartilaginous bars which are incomplete* posteriorly so that a flat surface presents itself to the membranous esophagus posteriorly It is usually fixed above and stretches with motion of the head and neck It follows the curves of the spine and hence recedes from the skin as it descends into the thorax

In the neck the trachea is surrounded by the isthmus and lobes of the thyroid gland the carotid sheath laterally and the esophagus posteriorly The recurrent laryngeal nerves are on either side in the groove between esophagus and trachea In the midline it is covered by fascia which separates it from the sternohyoid and thyrohyoid muscles on either side This linea alba is the best surgical approach for tracheotomy Occasionally a large thyroid ima artery ascends on the anterior surface The innominate artery is situated between the trachea and the manubrium sternum

In the chest the trachea is in relation to the arch of the aorta and its branches in *front and* to the left on the right to the vagus nerve and the right apex of the pleura on the left to the subclavian artery and the recurrent laryngeal nerve

The *right and left main bronchi* are formed by the bifurcation of the trachea and run obliquely downward and outward to the periphery of each lung The *carina* usually lies slightly left of the midline so that the right bronchus is more a direct continuation of the trachea and usually lodges foreign bodies (p 2016) The left main bronchus is longer than the right At the hilum are bronchial lymph nodes which drain the pulmonary and bronchial structures

The *right main bronchus* is subdivided into upper middle and lower lobe branches On the left there is no middle lobe the branch to the corresponding portion of the left lung coming off the upper lobe bronchus

lapse of the lungs the treatment of certain types of bronchial stenosis and status asthmaticus and for the removal of foreign bodies

METHODS OF TREATMENT

The majority of the simpler methods of treatment for respiratory disorders are the province of the practitioner Certain of the technics are taught the patient or a member of the household, others constitute office or bedside procedures More complicated non operative and operative measures are referred to the specialist consultant

Nasal Irrigation—Nasal irrigations are given with an irrigating can provided with no more than 2 or 3 feet of rubber tubing and a special glass irrigating tip The can is filled with normal saline solution improvised by adding 2 teaspoonfuls of table salt to a quart of water The fluid is heated to a temperature of 100° to 110° F

The patient sits up and holds the head over a basin The nozzle is introduced into the nostril of the less involved side The fluid in the reservoir should be less than 18 inches above the level of the nose The fluid is then permitted to run through the one nostril and out the other Later the position is reversed The more involved side is then used for the inflow

Throat Irrigation—The throat irrigation is accomplished with the apparatus used for the nasal irrigation Hot strong tea provides an optimum vehicle

The patient bends forward over a basin The fingers of one hand are used to depress the tongue The other hand holds the irrigating tip and points the flow against the posterior pharyngeal wall and faucial tonsil during the expiratory phase During inspiration the flow is shut off to prevent aspiration of fluid into the lower respiratory passages

Nasal Instillation—Nasal instillations are employed in the topical administration of vasoconstrictor and local anesthetic substances *Aqueous* solutions are to be preferred since the instillation of oil may result in the production of lipoid pneumonia particularly in the case of young children and stuporous or cachectic adults

Nasal instillation may be effected with ¼ per cent neosynephrine 1 1000 epinephrine chloride 2 per cent ephedrine sulfate or any other of the newer vasoconstrictor substances The drugs are instilled in the nostrils while the patient lies supine When the fluid is felt to trickle into the posterior pharynx the patient sits forward holding the no e between his fingers to prevent the escape of fluid He then lies in the right and then the left lateral decubitus to permit the dispersion of the drug over the widest surface area of the mucous membrane

Continual use of neosynephrine is to be deprecated as the drug itself may become responsible for chronic congestion of the nasal mucosa

Nasal Spray—The nasal spray accomplishes the same purpose as the nasal instillation The purchase of an atomizer adds to the expense of therapy but probably accomplishes a more satisfactory therapeutic result

The fluids used in the nasal spray are those described as the vasoconstrictor substances employed in the nasal instillation In the pre ence of marked congestion the sympatheticommimetic substance may be fortified by 1 to 2 per cent cocaine hydrochloride or a cocaine substitute Contin

in children without anesthesia In adults the larynx should be thoroughly anesthetized with 20 per cent cocaine or 2 per cent larocaine or pontocaine In direct laryngoscopy the surgeon holds the laryngoscope in his left hand and introduces it over the dorsum of the tongue to expose the tip of the epiglottis The lip of the instrument is passed beyond the epiglottis and the whole larynx is lifted anteriorly by a tilting motion of the laryngoscope permitting complete view of the laryngeal lumen A square of gauze is placed over the upper teeth to prevent injury by the laryngoscope For special exposure of the anterior commissure a triangular anterior commissure laryngoscope is used

Direct laryngoscopy is indicated for the inspection of the larynx in children with *croup* and *stridor* and in adults with *ulceration* or *neoplasm* Many patients with *diphtheria foreign bodies multiple papillomas* and *subglottic edema* can be treated by direct laryngoscopy

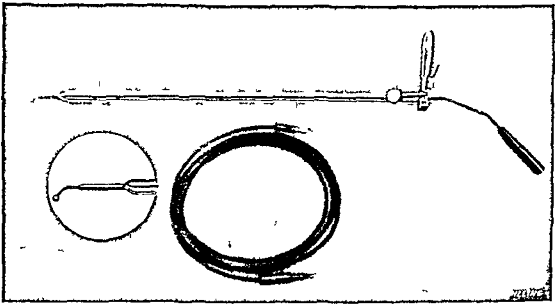


Fig 458—Bronchoscope and electrodes used for electrocoagulation *

BRONCHOSCOPY —The bronchoscope is introduced in a fashion similar to the laryngoscope When the larynx has been reached the tube is gently insinuated between the vocal cords and passed into the trachea If the right bronchial tree is to be studied the tube should be introduced through the left angle of the mouth and vice versa The bronchial mucosa should be anesthetized by local application of 20 per cent cocaine and adrenalin The bronchial tree can be examined down to the terminal divisions of the main bronchi and their subdivisions

Bronchoscopy offers the most exact and direct method for the diagnosis of *lung abscess* and *bronchial neoplasm* (p 2075) Biopsies can be taken and spreads and cultures are obtained Bronchoscopy is of invaluable assistance in the removal of inspissated secretions in massive col

* Jackson and Jackson Diseases of the Ear Nose and Throat

lapse of the lungs the treatment of certain types of bronchial stenosis and status asthmaticus and for the removal of foreign bodies

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The use of the higher concentration often replaces the hypodermic injection Patients may self medicate and save themselves untold distress

Steam Inhalation —The steam inhalation gives considerable symptomatic relief in inflammatory disturbances of the respiratory mucous membranes Steaming is best and least expensively performed over an open basin The source of the steam vapor may also be a kettle or an inexpensive electric vaporizer

The best results from steaming are obtained when the patient is placed under a hood The inhalations should not be continued for more than ten minutes since they are depleting and evoke a profuse diaphoresis The addition of a volatile oil such as pine needle or eucalyptus or of compound tincture of benzoin contributes nothing to the therapeutic result beyond the odor and its psychological connotation

It is doubtful whether continuous steaming is advisable This practice produces an overheated damp room there is not adequate ventilation the patient s entire body is moist and clammy and the procedure may be as well productive of harm as benefit In all likelihood steaming should be limited to ten minute treatments at three or four hour intervals Provision should be made to sponge and dry the patient and change the night clothes after each treatment

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	Divide and make 15 capsules	
	S g One every 2 or 3 hours as needed	

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Therapy (p 3830) *Helium Therapy* (p 3831) *Nebulization* (p 2118) *Aerosolization* (p 2041)

Climatotherapy —See p 3761 Artificial Respiration —See p 3766

Roentgen Therapy —Roentgen therapy and local applications of radium are of greatest value in the treatment of malignancies (p 2066) In our experience irradiation is useful also in the control of pertussis if given early in the disease (p 284)

Thoracentesis —Pleural fluid is withdrawn for diagnostic or therapeutic reasons For the former simple aspiration by syringe is adequate For the removal of large quantities of fluid, a *Potain aspiration* is necessary

The patient sits up in bed leans forward and places the hand of the affected side on the opposite shoulder The appropriate intercostal space is selected The overlying skin is painted with tincture of iodine and washed

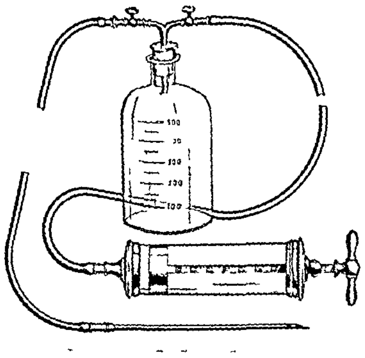


Fig 459 —Suction bottle outfit for therapeutic puncture of the pleural cavity *

off with alcohol The site of injection should be immediately above the lower rib since the intercostal vessels run along the lower surfaces of the ribs

A sterile hypodermic syringe containing 1 or 2 per cent procaine is employed to raise a small intradermal wheal about 2 cm in diameter and to infiltrate the subcutaneous tissues Within five minutes there should be sufficient anesthesia to permit penetration by the aspirating needle

For *diagnostic aspiration* a 14 gauge needle about 3 inches long is attached to a 20 cc record syringe The latter is grasped firmly in the palm of the hand and the needle is steadied by the index finger The hand is braced against the chest to prevent sudden lunging of the needle deep

* Bickham Operative Surgery

into lung tissue The needle is gently forced through the anesthetized site until the pleura gives Sufficient fluid is withdrawn for diagnostic purposes

For the *therapeutic removal of larger quantities of fluid* the needle is quickly connected to a *Potain set* This should have been previously prepared so that there exists a negative pressure in the gallon bottle The set consists of a two hole rubber stopper each hole pierced by a metal cannula provided with a stop cock One of the cocks is connected by rubber tubing to a two way mechanical air pump Tubing from the other runs to an adaptor that fits into the chest needle

To produce a vacuum in the bottle the needle cock is turned off and the pump cock is opened Air is forcibly withdrawn from the bottle by means of a piston pump with arrows indicating the direction of the flow When a sufficient vacuum has been created the piston cock is turned off

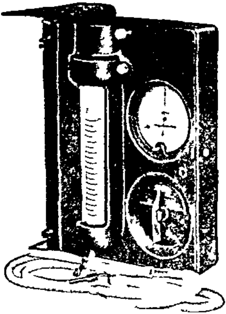


Fig 460—Pneumothorax set.

and the vacuum is tested by placing the needle in sterile solution opening the needle cock and observing the entrance of the fluid into the bottle If this is satisfactory the needle cock is shut off

When the pleural cavity has been entered the needle cock is opened whereupon pleural fluid should flow directly into the bottle

If the flow of fluid diminishes or ceases and the physical signs in the chest give evidence that additional fluid is present the negative pressure should be restored Under these circumstances the needle cock is turned off the piston cock is opened and air is withdrawn from the bottle When the pull on the piston indicates that there is a sufficient vacuum the piston cock is turned off and the needle cock is again opened The greatest care must be taken that no technical blunder occurs in the management of the cocks

DIFFERENTIAL DIAGNOSIS OF

Pleural Effusion

The pleural cavity may contain small or massive amounts of fluid In hydrothorax the effusion is due to the outpouring of transudate or exudate Hemothorax represents a bloody effusion and chylothorax is characterized by the milky appearance of the aspirate In an empyema thoracis or pyothorax the material is frankly purulent

Transudate fluid is non inflammatory clear light in color of a specific gravity less than 1 018 and with only an occasional cell on microscopic examination Exudate fluid is straw colored the specific gravity exceeds 1 018 there is a flocculation of fibrin and microscopic examination discloses a variety of endothelial cells leukocytes erythrocytes bacteria or neoplastic elements with evidences of mitosis

Bloody effusions may be merely blood tinged or they may be almost a true representation of the circulating elements Chylous fluids develop a creamy layer on standing microscopic examination discloses many fat globules which stain with osmic acid and Sudan III there are few cellular elements and the specific gravity usually exceeds 1 012 In addition to true chylous fluids the chest may contain chyliform and pseudochylous effusions Chyliform fluid usually associated with pulmonary tuberculosis or malignancy has only a small content of fat which usually is the result of the breaking down of leukocytes and endothelial cells microscopic examination reveals a few large fat globules and many cytologic elements The pseudochylous effusion closely resembles diluted skimmed milk, it is associated with cardiac congestion amyloidosis hepatic cirrhosis and chronic nephritis the milky appearance is due to a pseudoglobulin and not to fat microscopic examination discloses no fat globules and the chemical analyses confirm the low percentage of fat and the high concentration of globulin In the pyothorax the pus may be thin or thick but microscopy reveals myriads of leukocytes and usually the pathogenic organism is easily found by direct smears

The physical signs of fluid in the chest include percussion flatness bulging and diminished movement of the intercostal spaces absent fremitus and breath sounds and contralateral deviation of the cardiac apex Just above the fluid level there may be a band of skodiac tympany with egophony and the opposite chest may reveal a posterior area of dulness with accentuated breath sounds (Grocco s triangle)

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Traumatic	Hemothorax with penetrating and non penetrating wounds involving rib chest wall or lung Check x rays
Cardiovascular	Hydrothorax or pseudochylous effusion in backward failure Hemothorax with rupture of aortic aneurysm or pulmonary infarction
Hemorrhagic Diatheses	Hemothorax with hemophilia with scurvy and therapeutic response to cevitamic acid (p 1121) with vitamin K deficiency and therapeutic response to menadione (p 1113) with leukemia and thrombocytopenic purpura and characteristic hemograms (p 3704)
Metabolic	Hydrothorax with nephropathie particularly nephrosis and other conditions associated with hypoproteinemia (p 706) Pseudochylous effusion in amyloidosis with hepatosplenomegaly
Generalized Infection	Hydrothorax with lymphocytes or chyliform fluid in tuberculosis with demonstrable acid fast organisms or positive guinea pig inoculation (p 63) Transudate in acute rheumatic fever with therapeutic response to salicylate (p 194) Chylothorax in filariasis with microfilaria demonstrable in blood at night (p 3324) Transudate with characteristic eruption in disseminated lupus erythematosus (p 3399)

CONTINUED

Polyserositis	Disturbance of unknown etiology with hydrothorax, ascites and pericardial effusion.
Intrathoracic Infection	Hydrothorax or empyema thoracis with lobar pneumonia acute pneumonitis lung abscess acute pleuritis acute mediastinitis chronic tuberculous pneumonitis and chronic non tuberculous pneumonitis Examine fluid by microscopy smears and cultures (p 39)
Subdiaphragmatic Infection	Sympathetic effusion with hepatic subdiaphragmatic or subphrenic abscess Refer to surgeon for diagnostic aspiration and operation.
Neoplasm	Bloody fluid or hemothorax with mitotic elements in primary or metastatic neoplasms of pleura and lungs Get x rays and send fluid to pathologist for concentration and biopsy (p 2078) Chylous effusions with obstruction to thoracic duct due to intra abdominal or mediastinal malignancy Send fluid to pathologist for concentration and biopsy

No more than 1 liter of fluid should be removed at any given time If the patient begins to cough or complains of pain or tightness in the chest the rate of flow may be slowed by partially closing the needle-cock

Bloody expectoration should lead to immediate withdrawal of the needle Carelessness in technic may produce varying degrees of pneumothorax or hydropneumothorax Air usually enters the chest when the diagnostic syringe is removed and the adaptor of the Potain apparatus attached Consequently in the presence of evidences of a large pleural effusion the needle should be introduced when it is already attached to the cannula of the Potain set omitting the diagnostic puncture with the syringe

Pneumothorax—The induction of artificial pneumothorax requires the clinical judgment and the skill of the expert Certainly the patient s first pneumothorax should be produced by the consultant The subsequent ones may be done by the careful general practitioner

Indications for this procedure in pulmonary tuberculosis are cavitation persistent or highly positive sputum in patients with exudative and exudative productive lesions and hemorrhage predominant in *one* lung The artificial pneumothorax rests the lung and produces local changes unfavorable to the growth of the tubercle bacilli *Contraindications* are associated incurable disease and conditions which limit respiratory exchange such as advanced bilateral tuberculosis asthma and cardiac disease Pregnancy youth old age tuberculous laryngitis or enteritis are not contraindications

Technic—The pneumothorax apparatus consists of two connected liter bottles each half full of water The levels of fluid are changed by altering the respective heights the water flowing from the higher bottle to the lower The fluid in the higher bottle is replaced by air which enters through a glass tube inserted in the stopper The air in the lower bottle is compressed or forced through an out flow tube which contains a sterile cotton

filter and is connected by a three way stop cock to a water manometer and a needle There are many variations of this apparatus but the principle is usually the same

The usual *site of introduction* of pneumothorax is the fifth interspace in the mid or posterior axillary line This varies with the site of the lesion and the locations of adhesions Puncture should not be done directly overlying the site of the lesion or adhesions

A preliminary injection of *morphine* is advisable The patient lies on the side opposite to the pneumothorax or sits up supported by cushions with his arm stretched over his head The sterilized skin is infiltrated with procaine which is then injected into the intercostal tissues The pleura is penetrated by the needle With the entrance into the pleural cavity,

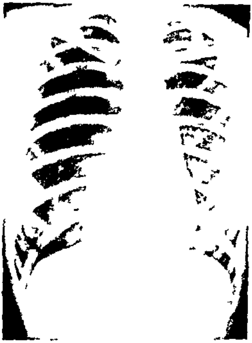


Fig 461 —Roentgenogram of pneumothorax right *

the manometer registers a negative pressure and the free respiration oscillations exceed 2 cm of water When these conditions have been fulfilled air is introduced until pressure readings repeated after the entrance of each 50 cc rise to atmospheric levels The amount of air injected at a first fill depends on what is necessary to collapse the lung generally 250 cc but even 500 to 1000 cc may be required when there is active hemoptysis

Complications —The accidents and untoward events that occur with this procedure are *air embolism so called pleural shock* (which is probably unrecognized air embolism) *lung rupture collapse of contralateral lung* and *subcutaneous emphysema* and *pneumoperitoneum* Among the late complications are *adhesions* clear or purulent *effusions* and spread of

* Wilson in Pullen Medical Diagnosis

DIFFERENTIAL DIAGNOSIS OF

Pneumothorax

Pneumothorax is produced when atmospheric air is admitted into the pleural cavity The defect which permits of this abnormality may be created by penetration of the chest wall or through the establishment of a communication with pulmonary alveoli or tracheobronchial tree Should the opening permit the flow of air in only one direction, a valvular pneumothorax is created, and an increasing positive pressure builds up within the che t (tension pneumothorax) With the addition of fluid or pus to the trapped air the patient suffers respectively from hydropneumothorax or pyopneumothorax

Clinical Manifestations

The onset of pneumothorax is usually announced by severe pain in the side and shortness of breath On occasions the intensity of symptoms is such that the patient develops syncope Less often, the pneumothorax builds up gradually and the first intimation of its presence is afforded by physical examination or x ray (Fig 461)

With a sufficiently large pneumothorax, the lung collapses and physical signs are easily recognized The percussion note is hyperresonant to tympanitic fremitus is suppressed, breath sounds are conspicuously absent, rales are not heard, the mediastinum is displaced to the sound side and the intercostal spaces are seen to bulge but they lack the appearance of respiratory movement.

With the addition of a pleural effusion to the pneumothorax, a level of dulness to flatness is observed at the base an audible succussion splash may be heard when the patient is shaken and the coin sound (p 3541) may be elicited. As the positive pressure within the thoracic cavity increases or the amount of fluid becomes greater the mediastinum may be shifted contralaterally

The physical signs of pneumothorax are simulated by herniation of stomach or intestin into the chest as the result of a defect in the leaf of the diaphragm The importance of correctly differentiating the two conditions is apparent when the physician considers the evil consequences of an unwitting transthoracic aspiration of bowel Since physical signs may be quite misleading an x ray is mandatory before any procedure is countenanced. If necessary the patient should be given a barium meal to establish with certainty the absence of the opaque material in the intrathoracic structures Patients with pneumothorax should not ascend beyond 5000 feet

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Spontaneous Idiopathic	Most frequent in young healthy males Probably due to rupture of undemonstrable congenital cyst Usual history of exertion such as lifting or swimming Spontaneous re-expansion with normal temperature negative sputum and clear x rays
Traumatic	Penetrating wounds of chest wall Rib fracture Perforation by bronchoscope or intrabronchial foreign body Summon surgeon and prepare for thoracotomy
Infectious	During violent paroxysm of cough in pertussis lobar pneumonia chronic tuberculous or non tuberculous pneumonitis or rupture of lung abscess Urgent decompression required in tension pyopneumothorax particularly with rupture of putrid lung abscess Examine sputum for acid fast bacilli (p 52) Get chest x rays
Therapeutic	Induction of pneumothorax in unilateral pulmonary disease particularly tuberculosis

tuberculous infection in the same lung or to the other side These accident are much more frequent in acute fulminating cases and the fibrotic type of pulmonary tuberculosis

Refills—The second refill is done in twenty four hours and consists of 300 cc and a third in another twenty four to forty eight hours of a slightly greater amount Biweekly refills for several weeks followed by weekly refills are given depending on clinical and x ray findings This treatment may be necessary for several years after the sputum has become negative

Oleothorax—Oleothorax is similar to artificial pneumothorax except that antiseptic oil is substituted for gas or air Oleothorax has few, if any advantages over artificial pneumothorax The fact that it is not so easily reversible and that adhesive pleuritis may result led to its abandonment

NONOPERATIVE SPECIALIST TREATMENT

Reference is made to otologist or rhinologist for several valuable non operative measures of therapy

NONOPERATIVE TREATMENT BY THE OTOLOGIST

1 *Catheterization of the Eustachian tubes and dilatation of strictures* in patients with certain types of deafness (p 2015)
2 *Inflation of the middle ear* through compression by the Politzer bag—a procedure of questionable wisdom since its efficacy is short lived and the risk of blowing infection from the nose is of more than academic significance
3 The prescription of *hearing aid* (p 2006)

NONOPERATIVE TREATMENT BY THE RHINOLOGIST

1 The control of intractable *epistaxis* (p 2123)
2 *Drainage* and *ventilation* of the nose and accessory sinuses through sprays or topical applications of cocaine and the sympathetico mimetic amines (p 3869)
3 *Cocainization of the sphenopalatine ganglion* in the specific neuritis or neuralgia of that structure (p 1482)
4 *Lavages of the maxillary antra the sphenoids and the frontals* have been described under diagnostic procedures (p 2023) Sinus washes are also of value therapeutically but the practice may often be overdone In acute hydrops or empyema the procedure is fraught with definite danger In chronic infection when the membranes have become thickened and the cavity filled with polyps lavage offers little hope of cure Too frequent washings often irritate and add to the difficulties Unless circumstances are unusual the sinuses should not be touched until the acute infection has sub sided They should not be washed more often than at forty eight hour intervals If three to six treatments fail to yield a satisfac tory result *some other type of therapy should be considered* (p 2038)

5 The rhinolaryngologist functions most dramatically in maintaining the *patency of the airway and gullet* This may be done without operative procedure by the insertion of a *tracheal cannula* by *tracheal intubation* as it was performed in the old days when diphtheria was rampant by the removal of foreign bodies and tumors through the *bronchoscope* or *esophagoscope* (p 2026) by shrinking swollen and edematous structures of the rima glottidis by topical application under laryngoscopic control

SURGERY

The practitioner refers his patient to otologist rhinologist and general or thoracic surgeon for operative treatment

OPERATIVE TREATMENT BY THE OTOLOGIST

In the operative field the otologist performs myringotomy (paracentesis of the middle ear) and operations on the mastoid process and petrous bone Pre and postoperative antibiotic therapy are advisable if not imperative

1 *Paracentesis of the ear drum* has been greatly diminished since the introduction of the anti infective agents When the procedure is indicated it is wiser to summon an expert since an adequate well planned incision requires experience and may save the patient later complications Despite the efficacy of local anesthesia it is far kinder for the patient and easier for the operator if general anesthesia is induced in all patients except infants A whiff of nitrous oxide or intravenous pentothal (p 3923) provides optimum conditions for kindly and skilful procedure
2 *Operations on the mastoid process and petrous bone* are specialist province The procedures consist in exposure of the cells and removal of diseased bone The operation demands considerable skill to avoid injury to cranial nerves in the near vicinity and the penetration of the meninges or the lateral sinus Since anti infective therapy has been perfected operations for mastoiditis have become rarities and dreaded post mastoid complications are even less frequently encountered Of these it is possible successfully to treat *otogenic meningitis* by anti infective agents combining parenteral dosage with intrathecal instillation of penicillin *Cerebral* and *cerebellar abscesses* despite adequate non operative treatment must be drained and evacuated after craniotomy *lateral sinus thrombosis* requires trephining for exposure of the involved segment and removal of the infected clot or obliteration of the venous channel by pressure concurrent *ligation of the jugular vein* in the neck prevents contamination of the general systemic circulation
3 The operation of *fenestration* for the relief of certain types of deafness is under present consideration The procedure is extremely exacting and requires special instruments and exceptional training and experience

OPERATIVE TREATMENT BY THE RHINOLOGIST

The operative procedures of the rhinolaryngologist are varied and involve the nose and air passages as far down as the bronchi Without exception surgery of the respiratory passages can be accomplished under local anesthesia General anesthesia has the important drawback that loss *of the pharyngeal reflex invites aspiration of infected material and blood* clot into the lung providing a nidus for the later production of the anaerobic lung abscess (p 2215) In consequence the practitioner should urge his consultant except in the instance of young children who cannot cooperate to perform his procedures with thorough and complete cocainization (p 3598) Pre and postoperative antibiotic therapy are advised

Simpler Intranasal and Intra oral Surgery—*Intranasal operations* performed by the rhinologist include resection of the nasal septum antrotomy removal or cauterization of polyps or obstructing turbinates and various plastic procedures including the correction of harelip cleft palate and nasal deformities

Septal resections removal of polyps and turbinates have as their prime indications the clearing of the airway to secure better nasal and particularly antral drainage When they fail the criticism is not so much of the operative procedure as the indication since the persistence of difficulty implies that more extensive pathology was present than could be corrected by the mechanical features in and of themselves

Operations for harelip and cleft palate (p 2043) are plastic procedures of necessity They require the most expert handling and should be referred to the specialist Plastic procedures on the nose for the *cosmetic correction of nasal deformities* that are not obstructive are being done increasingly In the hands of the ethical and competent expert, the results are extraordinary and are not limited to the local appearance alone since there is often an associated personality change that exceeds all expectations

Radical Sinus Surgery—Radical operations on accessory nasal sinuses are technically difficult and accomplished successfully by only a limited number of operators The procedures include the *radical antral operation* usually performed through the buccal mucosa (Cauldwell Luc) *intranasal spheno ethmoidectomy* and the combination of *antrotomy* and *spheno ethmoidectomy* The *radical frontal operation* is performed through incision over the eyebrow Since sinus surgery involves infected tissue the patient must receive ante operative and postoperative antibiotic therapy with penicillin and/or sulfonamide

Surgery of the Throat—In the throat the standby of the specialist is *tonsillectomy* When possible this should be postponed until adult life when the procedure can be done under local anesthesia and the risk of hyperplasia of lymphoid remnants is reduced In young children tonsillectomy is done under general anesthesia and is accompanied by *adenoidectomy* the lingual tonsil being removed as well

Lingual tonsillectomy as an isolated procedure is a simple technic that requires considerable skill and often provides grateful relief to intractable throat pain and cough

In the region of the throat the specialist is also summoned to *incise a peritonsillar or retropharyngeal abscess* In an exigency the practitioner may evacuate these abscesses but the risk of hemorrhage from the large

underlying vessels justifies consultation The technic of *tracheotomy* should be familiar to practitioner as well as specialist since the indications may be too urgent to permit delay

Operative procedures of the larynx trachea and bronchi certainly require expert attention Locally by direct laryngoscopy the cords may be *stripped biopsies* may be taken and small neoplasms removed the larynx and subglottic area may be *scarified* in edematous conditions such as angioneurotic edema (p 2101) and the *bronchoscopic removal of foreign bodies and tumors* stays life and prevents chronic pulmonary disease (p 2096)

Laryngectomy or *laryngeal fissure* for removal of an involved cord for malignancy are specialist procedures that yield gratifying results

MAJOR SURGERY BY THE THORACIC SURGEON

Surgery of the chest and intrathoracic structures requires consultation with the general surgeon or the subspecialist thoracic surgeon Pre- and postoperative antibiotic therapy are mandatory

Thoracotomy —Thoracotomy is performed for drainage of a suppurative infection in the pleural cavity (p 2222) The procedure is accompanied by *wide open drainage* when there is a pyopneumothorax and *closed drainage* for bland nonputrid pleural infections

Operation is generally deferred if possible until the pleural exudate is well localized and definitely purulent At this time under local anesthesia through a small stab wound a catheter can be inserted into the pleural cavity and connected by a shield to a water bottle arranged for under water drainage If the exudate is thick *rib resection* is performed and an open thoracotomy is instituted Local instillations of penicillin or streptomycin may yield extraordinary results

Pneumonotomy —With lung abscess particularly of the putrid variety drainage is established by the production of a bronchial fistula The abscess is carefully localized and the incision is placed over the area of pleural adhesion so that free pleural cavity is not entered and contaminated during the course of the procedure Incision is carried into the abscess cavity (pneumonotomy) and a bronchial fistula is established remaining open until the infection in the pulmonary tissue has subsided

Pneumolysis —The freeing of pleural adhesions is justified in the effort to permit adequate collapse therapy

Pneumonectomy or Lobectomy —Partial or complete pneumonectomy or lobectomy is required for neoplasm of the pulmonary tissue or in the presence of chronic infection which is localized relatively sharply to a single area The latter may be bronchiectatic or tuberculous

Phrenic Avulsion —Operations on the phrenic nerve are done by crushing or avulsion producing paralysis of the corresponding half of the diaphragm resulting in decrease of 20 to 30 per cent of lung volume Estimates of usefulness vary between enthusiasm and discouragement The operation is indicated as preliminary to thoracoplasty in conjunction with an unsatisfactory artificial pneumothorax (p 2033) when the patient refuses the latter and as a substitute for artificial pneumothorax which has been unsuccessfully attempted

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The operation is performed under local anesthesia by incision into the subclavian triangle. For temporary effect the nerve may be injected with alcohol or crushed; for permanent effect it is avulsed.

Operative complications include bleeding from adjacent large vessel, damage to nearby sympathetic trunk producing Horner's syndrome (p. 1400), and damage to the thoracic duct.

Extrapleural Thoracoplasty.—Extrapleural thoracoplasty effects the *collapse of the chest wall and underlying lung* as the result of removal of large segments of ribs. The complete operation involves the removal of large portions of all ribs except the twelfth. The operation is usually done in three stages. Partial operation involves the third to seventh ribs (*selective thoracoplasty*).

Patients with low vital capacity and elderly patients with cardiovascular damage are poor operative risks. Careful preoperative preparation is essential. Cyclopropane anesthesia is particularly favored.

The first stage is limited to the first three ribs. After an interval of three to six weeks the second stage of another three or at most four ribs is done. The first stage is often accompanied by *pleural decollation* in which parietal pleura overlying the apex of lung is dissected to free the apex and permit its collapse.

Apicolysis.—*Apicolysis* involves pulmonary decollation plus removal of a segment of rib, usually the second, and filling in of the extrapulmonary space with a foreign body such as paraffin. The procedure has been mostly abandoned.

Special Postoperative Care in Thoracic Surgery.—Major intrathoracic surgical procedures tax the reserves of respiratory and cardiovascular system. Most such procedures directly *decrease the pulmonary bed*. Postoperative pneumonias are therefore much more serious, for the patient's pulmonary reserve has already been decreased by the operation. Furthermore the thoracic incision itself interferes with proper respiration. In general it may be stated that patients with a vital capacity of less than 2000 cc. will withstand major pulmonary operations very poorly. The diminution in pulmonary area as well as postoperative defects and deviations of the mediastinum put a strain on the right heart, so that *heart failure* is common. In addition these procedures produce shock, giving rise to a therapeutic impasse, since the indicated transfusion may precipitate a pulmonary edema.

After thoracotomy patients may develop *tension pneumothorax* manifested by increasing dyspnea and cyanosis and mediastinal shift. Thoracotomy with underwater drainage must be established immediately. If a tube has been placed in situ during the operative procedure it must be inspected for patency and proper function. *Massive pleural effusion* which may develop post thoracotomy also requires immediate drainage.

After lobectomy or pneumonectomy, the *suture line of the bronchial stump* may disrupt with the immediate development of respiratory embarrassment or the subsequent development of a *putrid empyema*. Post-[illegible] of the unoperated side is frequent; it is due to impaired respiratory excursion, abolition of the cough reflex and spillage of infected material into uninvolved lung.

Following pneumonotomy for lung abscess, postoperative *hemorrhage*

y be due to erosion of pulmonary vessels by extension of the abscess by pressure from the drain These hemorrhages may rapidly assume alarming proportions with bleeding through the wound and through the mouth as an hemoptysis The emergency demands immediate examination of the wound and control of bleeding by packing

Each patient for whom thoracic surgery is indicated warrants preoperative and postoperative antibiotic therapy with *penicillin* (p 106) and/or *sulfonamide* (p 88) reserving *streptomycin* (p 104) for special instances of invasion by sensitive organisms such as *P tularensis* or *M tuberculosis* Additionally an oxygen tent must be in readiness for reception of the patient after return from the operating room and for immediate use if indicated in the postoperative period

Aerosolization —Aerosolization the production of a fine suspension of a solid or a liquid in a gas permits direct administration of therapeutic agents to nose throat sinuses larynx bronchi and pulmonary alveoli The aerosol is formed by the passage of a gas through the medication in a nebulizer operated by hand (p 2118) or by oxygen supplied from a tank at a rate of six liters per minute (Fig 461A)

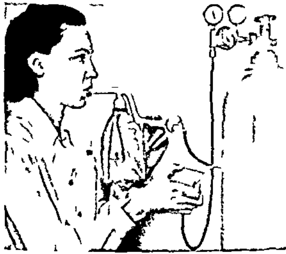


Fig 461 A—Aerosol apparatus (Keefe and Keefe)

Penicillin aerosolization with 50 000 units per cc is effective in the treatment of primary invasions by sensitive organisms of the upper and lower respiratory tract and also is helpful in the case of penicillin resistant infections when it prevents secondary invasion and complications Streptomycin aerosolization merits trial in infections with such sensitive organisms as *H pertussis* *M tuberculosis* *P tularense* and *K pneumoniae* (Friedlander) Promin aerosols are used also in tuberculosis and aluminum powders in silicosis (p 2066)

2

CHAPTER 100

THE RESPIRATORY SYSTEM CONGENITAL ANOMALIES MECHANICAL AND CHEMICAL INJURIES NEOPLASMS

Congenital Anomalies
- Cystic Disease of the Lung
- Deaf Mutism

Mechanical Injuries
- Lipoid Pneumonia
- Atelectasis
- Pulmonary Emphysema
- Bronchiectasis

Chemical Injuries

Neoplasms
- Cyst of the Nose
- Papilloma of the Nose
- Malignancy of the Nose
- Dentigerous Cysts Mixed Tumors and Cylindromas of the Nasal Accessory Sinuses
- Osteomas of the Nasal Accessory Sinuses
- Malignancy of the Nasal Accessory Sinuses
- Juvenile Fibromas of the Nasopharynx
- Schmincke Lympho epithelioma of the Nasopharynx
- Papillomas Fibromas and Angiomas of the Oropharynx
- Carcinoma of the Tonsil
- *Carcinoma of the Uvula*
- Carcinoma of the Epiglottis
- Lymphosarcoma of the Tonsil
- Benign Tumor of the Larynx
- Carcinoma of the Larynx
- Adenomas of the Tracheobronchial Tree
- Malignant Tumors of the Trachea and Bronchi
- Primary Carcinoma of the Lung
- Metastatic Tumors of the Lung
- Tumors of the Chest Wall
- Benign Tumors of the Pleura
- Primary Malignant Tumors of the Pleura
- Metastatic Pleural Tumors
- Benign Tumors of the Mediastinum
- Malignant Tumors of the Mediastinum
- Acoustic Neurinomas
- Epithelioma of Auricle
- Osteoma of External Auditory Canal

CERTAIN congenital anomalies of the respiratory organs are successfully remedied by expert plastic or endobronchial surgery In evaluating elective procedures such as the correction of nasal deformities the practitioner considers *psychotherapeutic possibilities* in addition to mechanical factors

TABLE 127.—CONGENITAL ANOMALIES OF THE RESPIRATORY SYSTEM: THEIR CLINICAL MANIFESTATIONS AND TREATMENT

Lesion	Clinical Manifestations	Treatment
Deformities of nose	"Hawknose," hooknose, redundant or bulbous tip	*Rhinoplasty*
Atresia of anterior nares	Nasal obstruction	Plastic surgery
Collapse of alae nasi	*Weakness of lateral wings of alar cartilages* produces inspiratory collapse, nasal obstruction and increase of negative pressure within nasal cavity	Plastic surgery
Atresia of posterior choanae	Unilateral or bilateral nasal obstruction and discharge, anosmia, difficulty in nursing, mouth breathing. Probe or catheter introduced intranasally meets obstruction	Intranasal removal of bony obstruction and adjacent portion of posterior nasal septum
Cleft palate	See page 1686	Surgery
Harelip	See page 1683	Surgery
Agenesis of paranasal sinuses	Frontals fail to develop. Distinguish between absence and radiopacity due to disease	None required
Web or diaphragm of larynx	Dyspnea, hoarseness, dysphonia and asphyxial episodes in infancy. White diaphragm seen on laryngoscopy (p. 2076)	Surgery
Laryngeal stridor	Larynx small, cartilages weak, folding of *epiglottis*, aryepiglottic folds and arytenoids into larynx on inspiration. *Stertorous "crowing"* inspiration increased by activity, crying or respiratory infection. *Diagnosis by direct laryngoscopy;* symptoms *disappear after second year*	Conservatism and palliation
Diverticula of larynx	Sac-like formations arising from lateral ventricle. May extend into neck. Laryngoceles	Excision if obstructive
Cysts and fistulas of neck	Persistence of branchial clefts. May be median or lateral	Excision
Webs of bronchi and bronchostenosis	May not be rare. *Diagnosis* by bronchoscopy with evidences of obstruction or infection	Endobronchial *incision* or dilatation
Absence of lung	Usually left-sided with anomalies of diaphragm (p. 2044). May be asymptomatic	None
Cystic disease of lung	See page 2044	None
Funnel breast	Sternum depressed to spine. Usually asymptomatic but may result in cardiac embarrassment	None
Absence of *auricle*	*Obliteration of external auditory canal*	*Plastic surgery*
Microtia	Small ears	None
Macrotia	Large ears	Plastic surgery
Stenosis of external auditory canal	Impaction of cerumen	*Plastic surgery*
Mutism	See page 2045	

CYSTIC DISEASE OF THE LUNG

Congenital cysts of the lung lined with bronchial epithelium may result from bronchial occlusion or atresia The cysts may be single or multiple they may contain fluid and/or air

Clinical Manifestations—Cystic disease of the lung usually is *asymptomatic* Often the condition is discovered through the characteristic honeycombed' appearance of the lower lobe in a roentgenogram taken for some other purpose The roentgen picture suggests the pulmonary excavations



Fig 462—Atresia of the nares before operation and after *



Fig 463—Atresia of the ear canal before operation and after *

of a *tuberculosis* (p 2204) but tubercle bacilli are absent from the sputum and systemic symptoms are conspicuous by their absence

On rare occasions congenital cysts produce symptoms as the result of mechanical alterations hemorrhage or secondary infection A rapid increase in a balloon cyst may cause an acute episode of *dyspnea* (p 2016) with such marked displacement of the mediastinum that aspiration of the cyst is required as a palliative measure Frequent *hemoptyses* (p 2058)

* Smith in Jackson and Jackson Diseases of the Ear Nose and Throat

have been encountered superimposed secondary infection gives rise to repeated incidents of *acute pneumonitis* (p 2185) or disturbances which suggest the presence of *pulmonary suppuration* (p 2214) *empyema thoracis* (p 22?2) or *bronchiectasis* (p 2059) Following the subsidence of the acute episode the diagnosis becomes apparent from the persistence of roentgenological manifestations

Treatment—The recognition of cystic disease *of the lung is of academic* importance as long as the condition is asymptomatic *If* there are repeated mechanical disturbances bleedings or secondary infections however the production of an *artificial pneumothorax* (p 2033) is worthy of consideration in unilateral disease

DEAF MUTISM

Confronted with the problem of the congenitally deaf child the practitioner refers the parents to the nearest organization equipped for the expert management of this important problem



Fig 461—Cystic disease of the lung Anteroposterior and lateral views

Congenital deafness need not necessarily be accompanied by mutism Expert training may enable the youngster to acquire reasonably fluent speech The *sign and manual* methods are being increasingly replaced by education in *lip reading* and the *acoustic technics* The Special Committee on the Deaf Child appointed by the American Medical Association recommends exclusively oral instruction of deaf children and oral teaching of the congenitally deaf child and the acquired deaf child as part of the functions of the departments of the public school systems in all larger cities

MECHANICAL INJURIES

Most acute and many chronic mechanical lesions of the respiratory passages and ear require the attention of the expert In persistent mechanical disturbances such as the varieties of *pneumoconiosis* (p 2065) *lipoid*

Gray H K and Skinner I C, in Collected Papers of The Mayo Clinic vol 33

TABLE 198—MECHANICAL LESIONS OF THE RESPIRATORY TRACT THEIR MANIFESTATIONS AND TREATMENT

Lesion	Clinical Manifestations	Treatment
Foreign bodies in nose	Unilateral nasal obstruction and putrid or hemorrhagic discharge Usually in children	Removal
Rhinoliths	Depositions around foreign body nucleus	Removal
Deviation of nasal septum	May be asymptomatic May cause nasal occlusion nasal polyps chronic sinusitis mouth breathing septal hemorrhage and ulceration *Reflex headache and hearing defects through* obstruction of eustachian tube	Submucous resection
Perforations of septum	Rarely syphilitic usually traumatic or postoperative	
External deformities of nose	Congenital (p 2013) or traumatic hawk hook bulbous flattened or depressed Marked psychological overtones	Rhinoplasty
Fractures of nose	See p 3013	
Elongation of uvula	May be asymptomatic or the cause of irritation and chronic cough	Amputation
Foreign bodies of pharynx or tonsils	Usually fish or chicken bones or quill	Removal
Tonsillolith	Calcification of secretion of crypt usually asymptomatic	Removal
Occlusion of posterior nares (p 2140)	Usually by adenoid growths Mouth breathing snoring nasal discharge	Adenoidectomy
Hypertrophy of lingual tonsils (p 2159)	Chronic cough worse on reclining	Removal
Injuries of the larynx	Wounds may be accompanied by obstruction of airway Specialist consultation for endoscopy or tracheotomy	Specialist
Misuse of voice	Dulness of cords later redness and weakness of thyro arytenoid muscles finally nodular swellings (singer's nodes)	Specialist but avoid cauterizations and attempts at removal of nodes
Burns of larynx	Vapors molten metals and lye Associated edema may cause obstruction	Specialist for endoscopy and tracheotomy if necessary
Stenosis of larynx	Follows burns and injuries	Specialist for dilatation or operation
Foreign bodies of larynx trachea and bronchi	History or signs of local obstruction localized asthmatoid wheeze or atelectasis recurrent localized pneumonitis or lung abscess	Endoscopy with removal if possible by expert
Injuries of chest wall and ribs	May be accompanied by hemothorax (p 2037) pneumothorax (p 2033) atelectasis (p 2059) or rupture of lung	Roentgenogram and treatment of intrathoracic injury
Penetrating wounds of chest wall	Non sucking perforations require only removal of foreign bodies and prophylactic chemotherapy Sucking wounds require closure and restoration of normal intrapleural pressure prophylactic chemotherapy	Surgical consultation

TABLE 128.—MECHANICAL LESIONS OF THE RESPIRATORY TRACT THEIR MANIFESTATIONS AND TREATMENT (*Continued*)

Lesion	Clinical Manifestations	Treatment
Contusions of lung	*Usually with fractures of ribs hematomas* under pleura hemothorax	*Conservative treat ment*
Hydrothorax	See p 2032	
Pneumothorax	See p 203[illegible]	
Hemothorax	See p 2032	
Chylothorax	See p 2032	
Displacement of mediastinum	See p 2084	
Emphysema of mediastinum	With mediastino bronchial penetration or fistula subcutaneous emphysema of neck and venous engorgement of head and neck may be spontaneous from ruptured bleb and be accompanied by pneumothorax	Emergency surgery
Mediastinal flutter	With sudden displacements of intrathoracic pressures may be fatal	
Diaphragmatic hernia	Hiatus hernia (p 1803) or trauma with perforation of diaphragm may be asymptomatic or associated with epigastric distress occasional hematemesis may incarcerate diagnosis by roentgenology	May require surgery
Eventration of diaphragm	Thinned central leaf bulges into thoracic cavity displaced abdominal organs give bizarre signs diagnosis on fluoroscopy	Surgical consultation
Frostbite of ear	See p 2113	
Hematoma of external ear	See p 3961	Evacuation to prevent perichondritis
Foreign bodies and cerumen in canal	May be asymptomatic or cause of pruritus and impairment of hearing	Irrigation
Traumatic perichondritis of ear	Cauliflower ear	Plastic surgery
Strictures of external auditory canal	Favor impaction of cerumen and furunculosis	Plastic repair
Hyperostoses of external auditory canal	Favor impaction of cerumen and furunculosis	Specialist
Injuries of external ear	Ecchymoses lacerations	Surgery
Rupture of ear drum	Violence airplane foreign body blast with skull fracture	Specialist prophylactic chemotherapy
Stenosis or obstruction of eustachian tube	May cause recurrent otitis and impairment of hearing	Specialist for dilatation
Lipoid pneumonia	See p 2048	
Atelectasis	See p 205[illegible]	
Emphysema	See p 2056	
Bronchiectasis	See p [illegible]059	

pneumonitis (p 2048) *emphysema* (p 2056), *atelectasis* (p 2052) and *bronchiectasis* (p 2059) best efforts are directed at prevention since most of the manifestations are irreversible

Lipid Pneumonia (Lipoid or Oil Aspiration Pneumonia)

Lipid pneumonia is a proliferative interstitial pulmonary reaction which results from aspiration of oils or fats

Etiology—*Animal fats* (cod liver and halibut oils) *vegetable oils* (castor and olive oil) and *mineral oil* (liquid petrolatum) may produce lipid pneumonia when they are aspirated *Cod-liver oil* is the most irritating and causes an exudative reaction in the pulmonary tissues *mineral oils* evoke a more chronic and proliferative response some vegetable oils such as *iodized poppy seed oil* which is used in bronchography (p 2061) are apparently without toxic effects but *peanut* oil is intensely irritating

Pathogenesis—The most frequent causes for lipid pneumonia are aspirations of cod liver oil and liquid petrolatum The former is responsible for the lipid pneumonias of infancy while the latter more often causes the disease in the adult



Fig 465 — Hump nose before and after operative correction *

Lipid pneumonia is not a common disturbance but it occurs at the extremes of life more frequently than is ordinarily believed In the majority of patients precipitating factors favor the passage of the medicinal oil into the respiratory tract In infancy these include *harelip* (p 1683) *cleft palate* (p 1686) vomiting overforceful feedings palatal paralyses or administration of the medicinal while the child is lying on the back The adult who develops lipid pneumonia usually suffers from a profound cachexia or a neurologic disorder associated with depression of the cough reflex or weakness of the muscles of deglutition

It is quite possible that lipid pneumonia may occur without exciting causation Patients who practice frequent nasal instillations of oil drops particularly while in the recumbent position may suffer an insidious seepage of material past the glottic barrier It is possible too that oil instillations and forceful spraying employed therapeutically for laryngeal lesions and bronchiectasis may produce a superimposed pneumonopathy

Pathology—The pulmonary pathological process varies with the nature of the oil and the amount that is aspirated Aspiration of *cod liver oil* in infancy produces a fairly acute and extensive inflammatory response macrophages are seen in the alveolar spaces and asphyxial death occurs in extreme instances When the causative agent is *liquid petrolatum* the process is more localized and chronic it is confined to the lung bases on the right more

* Jackson and Jackson Diseases of the Ear Nose and Throat

often than on the left side and in the posterior rather than the anterior portions Circumscribed nodular infiltrations have the appearance of a *neoplasm* With repeated aspirations there occurs a foreign body giant cell reaction with fibrosis scarring and obliteration of the normal pulmonary architecture

Clinical Manifestations—The majority of the lipid pneumonias occur without the production of clinical symptoms In acute disturbances caused by cod liver oil in infancy there may be episodes of *cough fever chest pain* and *dyspnea* of varying severity The physical signs at most are those of a mild *pneumonitis* (p 2189)

In the adult the physical signs are absent or they pass without note They may be interpreted as manifestations of *pulmonary hypostasis* (p

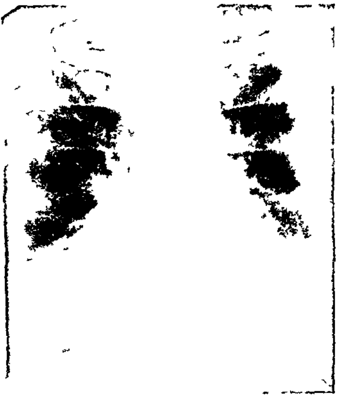


Fig 466.—Lipid pneumonitis Patient of 67 who had used oil atomizer several times daily for over twenty years

2193) or as repeated episodes of a *pneumonitis* (p 2185) Most often the condition is discovered only on chance x rays or at necropsy

Diagnosis—The diagnosis of lipid pneumonia challenges the clinical acumen of the practitioner In the presence of atypical pulmonary disorders in infancy and old age inquiry is made concerning the medicinal use of oils At most the diagnosis is suspected since there is no method by which its presence can be proved Roentgenograms may show persistent infiltrations of both bases without the presence of other factors such as tuberculosis or a previous pneumonia to account for the changes

DIFFERENTIAL DIAGNOSIS OF

Cough

Cough represents the reflex respon e of the respiratory tract in its effort to expel irritating and foreign bodies The cough reflex is not always an unmitigated blessing In pertussis for example the paroxysms may be violent and exhausting as well as ineffectual With immovable foreign bodies such as neoplasms the constant cough produces irritations of the larynx without relief to distress The emetic cough so characteristic of tuberculosis and pertussis produces further difficulty by impairing nutrition through anorexia fear of eating and loss of nutriment

The efficacy of the cough reflex is most clearly seen in infectious states where it is necessary for the airway to be cleared of secretion and exudate The practitioner encourages cough for purposes of drainage and withholds sedative mixtures in order to favor expulsion of infective material at the minor expense of patient discomfort

CAUSES	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Psychogenic	Hysteria Habit cough
Neurogenic	*Paralysis of recurrent laryngeal nerve* Prepare for tracheotomy (p 3958) Angioneurotic edema Try effect of epinephrine and prepare for scarification (p 3877) Bronchial asthma with relief from epinephrine Bulbar palsy with regurgitation of food through nose Reflex stimulation of otitic branch of vagus due to cerumen and foreign body in ear *Reflex irritation of phrenic nerve in diaphragmatic disturbances* Laryngismus stridulus in children with evidences of tetany
Vascular	Backward failure particularly with pulmonary edema Pulmonary embolization and infarction with bloody sputum and evidences of peripheral phlebothrombosis (p 1123) Hypertension of lesser circulation Arteriosclerosis *of pulmonary artery Acute and chronic peri*carditis Hypertrophy of left auricle due to mitral stenosis Note changes in cardiac silhouette (p 963) Aortic aneurysm with visible x ray lesion (p 968)
Chemical	Smoker s cough Inhalation of irritant gases in war and industry Pneumoconiosis in those who work with irritating dust
Mechanical Lesions of Upper Respiratory Tract	Postnasal drip from infected adenoids rhinitis or accessory nasal sinusitis Hypertrophy or infection of lingual or faucial tonsils Elongation of uvula Impaction of foreign body Aspiration of food. Regurgitation of food Supplement local inspection with x rays of sinuses and posterior rhinoscopy (p 2021)
Mechanical Lesions of Lower Respiratory Tract	Tracheal compression due to enlarged goiter Misuse of vocal cords Emphysema bronchiectas s atelectasis and lipid pneumonitis Get chest x ray and consider bronchoscopy (p 2026) Pneumothorax with characteri tic physical signs (p 2035) Compression due to elevation of diaphragm by gastric dilatation ascites or tympanites

CONTINUED

Generalized Infections	Upper respiratory infection. Influenza Pertussis with paroxysmal cough and lymphocytosis Measles with characteristic eruption. Diphtheria with ulceromembranous exudate containing organism. Pneumonic plague in epidemic areas with isolation of P pestis Hodgkin s disease with eosinophilia and characteristic biopsy (p 1139)
Local Respiratory Infections and Inflammations	Acute and chronic nasopharyngitis sinusitis laryngotracheitis and bronchitis Peritonsillar and retropharyngeal abscess Get direct smears and cultures of exudate (p 51) Lobar pneumonia acute pneumonitis chronic tuberculous pneumonitis chronic nontuberculous pneumonitis miliary tuberculosis putrid and aputrid lung abscess pulmonary furunculosis acute and chronic pleuritis acute and chronic mediastinitis and mediastinal lymphadenitis empyema thoracis and mycotic amebic and helminthic pulmonary infiltrations Obtain sputum for direct examination, stained smears and culture Get x ray of chest.
Otogenic	Reflex from otitis media with changes observed by otoscopy
Neoplastic	Of uvula tonsils nasopharynx, larynx, trachea bronchi lungs pleura and mediastinum. Get biopsy by direct aspiration or bronchoscopy (p 2075)

In chronic examples with nodular *paraffinomas* a *neoplasm* may be suspected to the *point where lobectomy* is performed The diagnosis is made with certainty only when the specimen is examined directly or progression of the lesion fails to occur after protracted observation The differentiation from *tuberculosis* (p 2200) is suggested by lower lobe involvement absence of constitutional manifestations and failure to find bacilli in concentrated sputum specimens

Treatment—Lipid pneumonia is a *preventable* disturbance The indiscriminate and prolonged use of nasal drops and sprays containing liquid petrolatum is not to be countenanced *Infants* who receive cod liver oil are fed *while in the upright position and the drops are added to the milk* formula rather than administered separately

Once a lipid pneumonia has developed the pathologic lesion is irreversible In an acute febrile episode a trial of *sulfonamide* (p 88) or *penicillin* (p 106) is advisable since the symptoms may be from superimposed secondary infection

Symptomatic Treatment of Cough

Correction of general hygiene Periods of silence after misuse of cords Abolition of smoking Use of masks in industry

Abolition of sensory irritation Removal of cerumen and foreign bodies *from ears* Strapping in pleuritis Systemic use of atropine and the opiates in conditions activated by Hering Breuer reflex (miliary

tuberculosis and carcinomatosis pulmonary infarction and bronchial asthma) Lavage of accessory nasal sinuses with retained secretion

Anti histamines Pyribenzamine or benadryl 50 mg

Removal of foreign body From upper respiratory passages larynx trachea and bronchi

Expectorants Liquor ammoniae anisatus 2 cc (30 minims) in $\frac{1}{4}$ glass of water every 2 hours

Cough sedatives Codeine phosphate 15 to 30 mg ($\frac{1}{4}$ to $\frac{1}{2}$ grain) dilaudid 2 mg ($\frac{1}{30}$ grain) hycodan bitartrate 5 mg ($\frac{1}{12}$ grain) or morphine 15 mg ($\frac{1}{4}$ grain) if necessary

Antispasmodics in bronchial asthma 1 1000 epinephrine 0.5 to 1 0 cc intramuscularly aminophyllin 0 5 gm ($7\frac{1}{2}$ grains) intravenously atropine sulfate 1 mg ($\frac{1}{60}$ grain) subcutaneously demerol 50 to 100 mg ($\frac{5}{6}$ to $1\frac{2}{3}$ grains) subcutaneously

Feeding by gavage (p 1752) In bulbar paralysis to prevent regurgitation of food

Inhalation of carbon dioxide (p 3830) In pulmonary atelectasis

Oxygen therapy (p 3827) Particularly in chronic passive congestion, backward failure and pulmonary embolizations

Surgery For removal of hypertrophied lingual and faucial tonsils elongated uvula and neoplasms from nasopharynx to bronchi Incision and drainage of peritonsillar and retropharyngeal abscess Thoracotomy for empyema Pneumothorax for unilateral chronic tuberculous and nontuberculous pneumonitis Drainage for pulmonary abscess

Thyroidectomy For tracheal compression due to goiter

Roentgenotherapy In mediastinal lymphadenopathy, pertussis and bronchiectasis

Artificial pneumothorax Especially for pulmonary cavitation

ATELECTASIS

In atelectasis the pulmonary tissue is airless and collapsed The condition may affect one or both lobes it may appear in scattered areas throughout the pulmonary tree

Pulmonary atelectasis may occur through *compression* or *obstruction* or by an acute mechanism that is probably *neurogenic* The latter is best illustrated by massive collapse most often encountered following operation

COMPRESSION ATELECTASIS

Compression atelectasis occurs secondarily as the result of a massive *pleural effusion* (p 2221) *hemothorax* (p 2032) or *pneumothorax* (p 2035) The atelectasis may be produced deliberately in order to assist in the healing of a tuberculous pulmonary infiltration (p 2200)

Treatment—The treatment of a compression atelectasis is directed toward the most fundamental lesion The pleural fluid is withdrawn or the air is released provided that the pulmonary parenchyma is ready for re expansion

OBSTRUCTIVE ATELECTASIS

Obstructive atelectasis results from occlusion of the airway by a *foreign body* (p 2046) *retained secretion* an *endobronchial tumor* (p 2075)

inflammatory swellings of the mucous membrane an *inflammatory stricture* most often the result of a healed tuberculous bronchitis or lymphadenitis and *extrabronchial pressure* from a malignancy or tuberculous nodes Obstructive atelectasis is demonstrable by *bronchoscopy* and often may be alleviated by the technical skill of the *endoscopist* (p 2024)

Smaller areas of obstructive atelectasis in the terminal bronchioles can not be visualized or corrected by endoscopy These scattered areas of pulmonary collapse arise in the course of *pertussis* (p 278), acute *pneumonitis* (p 2185) or *pulmonary embolization and infarction* (p 2086)

Treatment—The treatment of obstructive atelectasis in the larger ramifications of the bronchial tree requires the services of the *bronchoscopist* With his unusual skill he may remove a foreign body excise or destroy an endobronchial tumor (p 2077) abstract a plug of tenacious secretion

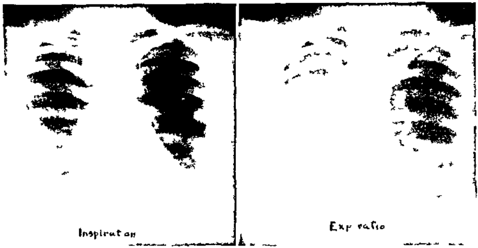


Fig 467—Obstructive emphysema of the left lung due to check valve obstruction by a bronchial carcinoma Note that the emphysema is most apparent on expiration because the unobstructed lung empties completely the left lung remaining ballooned The heart shifts over to the unobstructed side *

(p 2103) shrink the membrane by topical application of a vasoconstrictor or by cauterization and dilate a bronchial stricture or remove a web

Those areas that are not accessible to manipulative therapy may be expanded by forced *hyperventilation* In the conscious patient this is accomplished by deep breathing or blowing into bottles in uncooperative patients hyperventilation is stimulated by inhalations of 5 to 10 per cent *carbon dioxide* (p 3830) supplemented by antibiotic therapy

MASSIVE COLLAPSE OF THE LUNG

Massive collapse of the lung usually is seen as a *post operative complication* (p 4004) It is most frequent when the procedure involves the upper abdomen Its occurrence is favored by heavy dosages of the opiates and sedatives tight dressings abdominal distention and immobility of the body as a whole The combination of limited respiratory movement eleva

* Jackson and Jackson Diseases of the Ear Nose and Throat

tion of the diaphragm viscid bronchial secretion and suppression of the cough reflex creates circumstances favorable for the development of the complication

Clinical Manifestations—Postoperative pulmonary collapse usually develops *abruptly within three days following the procedure* The patient complains of *acute dyspnea anxiety cough* and *tightness* of the chest Cyanosis is noted the pulse rate becomes rapid the temperature rises and the leukocytes increase to 10 000 to 20 000 per cu mm A suspicious

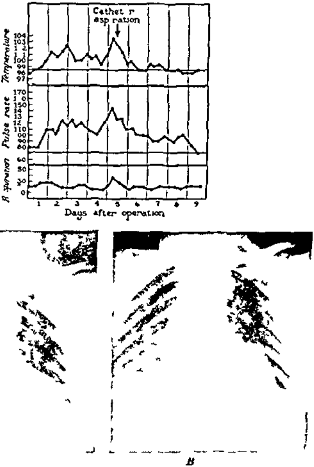


Fig 468—Postoperative atelectasis *A* Before and *B* after endobronchial aspiration In the chart above the effect of treatment on temperature pulse and respiration is evident

circumstance in the clinical picture is the lack of the degree of toxicity that might be expected if the lesion were on an infectious basis

The *diagnosis* of massive atelectasis is apparent from the physical evidences of displacement of the mediastinum diaphragm and chest wall The involved chest may appear collapsed particularly in relationship to the bulging sound side the intercostal spaces are narrowed the respiratory movement is relatively feeble and there is marked inequality in the excursion of the costal flare The apex of the heart is drawn toward the

* Schmidt, H W, Mousel L H and Harrington S W in J.A.M.A., *120* 895 *1942*

affected side as is the trachea percussion adds further evidence of the cardiac displacement the ateletatic area is dull to flat breath sounds are diminished to absent and fremitus is decreased

If roentgenograms can be obtained they confirm the shift of the mediastinum and heart elevation of the diaphragm is observed and the collapsed area is radiopaque

Diagnosis—The diagnosis of postoperative pulmonary collapse is strongly suggested by history and physical examination Differential diagnosis involves the consideration of pleural effusion postoperative pneumonitis and embolization with infarction

With *pleural effusion* (p 2220) the heart and mediastinum are displaced toward the sound side and diagnostic aspiration reveals the presence of fluid *Postoperative pneumonitis* (p 2189) develops more insidiously and the sputum is more prone to be purulent and blood stained there is no displacement of the mediastinum and heart the intercostal spaces are not narrowed

Postoperative embolization (p 2086) may be associated with manifest thrombophlebitis of an extremity vein the sputum is frankly bloody and displacements are not observed unless there is an associated atelectasis

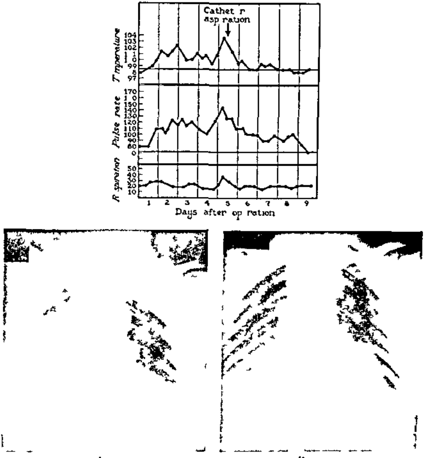
Treatment—In the management of the postoperative collapse of the lung the practitioner s best efforts are directed at prevention *Tight abdominal binders* are avoided particularly in procedures involving the upper abdomen *heavy sedation* is not countenanced and the patient is warned before operation to be prepared to bear a certain amount of pain and discomfort without requesting a hypodermic In basal anesthesia (p 3841) *avertin* is avoided in favor of the more rapidly excreted *barbiturates* (p 3839) *Abdominal distention* is prevented by prophylactic doses of *neostigmine* (p 3874) or *pitressin* (p 1178) The nurse is instructed to see that the patient moves freely and is turned from side to side at frequent intervals Following operation the lungs are hyperventilated by inhalations of 5 to 10 per cent *carbon dioxide* and as soon as consciousness returns the patient is instructed to take deep breaths at frequent intervals Viscid bronchial secretions are loosened by inhalations of steam

Active Therapy—Once the atelectasis has occurred a reflex collapse may be corrected by rolling the patient from side to side and by choosing the decubitus with the affected side kept uppermost *Hyperventilation* is encouraged by conscious deep breathing or inhalations of 5 to 10 per cent *carbon dioxide* If the lung fails to re expand and the patient is in distress a *bronchoscopic examination* (p 2024) is worthy of consideration since aspiration of the mucous plug may be life saving and is then followed by immediate aeration of the involved area *Oxygen therapy* (p 3827) which tends to limit the respiratory excursions provides symptomatic relief of the dyspnea Prophylactic antibiotic therapy with *penicillin* and/or *sulfonamide* is begun without delay

Atelectasis of an entire lung may be encountered in the course of *bronchial asthma* (p 2101) or *lobar pneumonia* (p 2171) With urgent symptoms expert bronchoscopic manipulation may produce an extraordinary therapeutic result if the fibrinous plug can be removed

tion of the diaphragm viscid bronchial secretion and suppression of the cough reflex creates circumstances favorable for the development of the complication

Clinical Manifestations—Postoperative pulmonary collapse usually develops abruptly within three days following the procedure The patient complains of *acute dyspnea anxiety cough* and *tightness* of the chest Cyanosis is noted the pulse rate becomes rapid the temperature rises and the leukocytes increase to 10 000 to 20 000 per cu mm A suspicious



A B

Fig 468—Postoperative atelectasis *A* Before and *B* after endobronchial aspiration In the chart above the effect of treatment on temperature pulse and respiration is evident *

circumstance in the clinical picture is the lack of the degree of toxicity that might be expected if the lesion were on an infectious basis

The *diagnosis* of massive atelectasis is apparent from the physical evidences of displacement of the mediastinum diaphragm and chest wall The involved chest may appear collapsed particularly in relationship to the bulging sound side the intercostal spaces are narrowed the respiratory movement is relatively feeble and there is marked inequality in the excursion of the costal flare The apex of the heart is drawn toward the

* Schmidt H W Mousel L H and Harrington S W in J.A.M.A *120* 895 1942

out the chest The area of cardiac flatness is obliterated the heart sounds are distant and the apex impulse cannot be palpated

Course —Emphysema follows a slow and progressive course with frequent attacks of intercurrent respiratory infection each of which leaves the patient somewhat more dyspneic and cyanotic Hypertension arteriosclerosis and manifestations of cardiac failure are frequently superimposed their effects are additive and cumulative

Treatment —The treatment of emphysema is wholly unsatisfactory At best efforts are made to prevent complicating respiratory infection by aerosolization (p 2041) prophylactic antibiotic therapy and anti influenza vaccine

Obese patients are subjected to *weight reduction* (p 697) and *smoking* is forbidden Earnest efforts are made to avoid the common upper respiratory infections (p 2105) the patient is instructed to mask when in contact with obviously afflicted individuals reliance should not be



Fig 469 —The barrel shaped chest of pulmonary emphysema

placed upon the ingestion of vitamins or injections of cold vaccines (p 2117) For the relief of accompanying bronchospasm capsules containing *ephedrine sulfate* (0 03 gm) and *phenobarbital* (0 03 gm) are taken three times daily Many patients note considerable comfort from the use of an *abdominal belt* The anti histamine agents pyribenzamine and benadryl in doses of 50 to 100 mg merit trial (p 565)

These simple measures failing to give relief the patient is advised to purchase an apparatus whereby frequent *inhalations of oxygen* may be taken through a mask Those who can afford the luxury profit by the installation of an *air conditioning unit* in bedroom or office

When the emphysema reaches the point of incapacitation the patient is urged to live within the framework of his vital capacity *Climatic cures* accomplish little other than a mechanism for escape (p 3761) the benefits

Norris and Landis Diseases of the Chest

Pulmonary Emphysema

In pulmonary emphysema the alveolar walls are thinned or ruptured and the air sacs are distended In the *hypertrophic variety* the chest is large and barrel shaped and the lungs are voluminous in the *atrophic type* the chest and lungs are normal or even reduced in size The atrophic type of emphysema occurs in older patients while the hypertrophic variety is more common in the middle aged

Etiology—Pulmonary emphysema results from interference with the elastic recoil of the alveoli during expiration Various hypotheses have been advanced for the origin of the lesion The condition may arise from a primary congenital weakness or defect of the *elastic tissue* of the lungs from degenerative changes in the *intervertebral disks* producing increased curvature of the dorsal spine and a greater anteroposterior diameter of the chest, or from *premature ossification* of the *costal cartilages* so that the chest wall remains in a fixed inspiratory position It may result from excessively high *intrabronchial* or *intra-alveolar tensions* due to occlusion of the lumen chronic cough paroxysms of pertussis (p 2i8) the distention behind a bronchospasm in asthma (p 2101) or work that requires heavy lifting or forced expiration as glass blowing and the playing of wind instruments

Pathology—The emphysematous lung is voluminous and distended it fills the entire thoracic cavity and covers the heart almost completely Its surface is pale and its tissue feels light and feathery Often there are large blebs under the visceral pleura Microscopically the alveolar walls are thinned and the individual cells coalesce to form large air sacs The capillaries of the septa are compressed and attenuated, partially explaining the development of pulmonary arterial hypertension and arteriosclerosis with hypertrophy and dilatation of the right ventricle In association with the emphysema, there is almost invariably chronic inflammation and it is often impossible to tell which of the conditions preceded the other

Clinical Manifestations—In the majority of instances emphysema i asymptomatic When the emphysema develops on the basis of a preexistent asthma chronic bronchitis or bronchiectasis the evolution of symptoms is gradual and progressive The patient first notes *exertional dyspnea* (p 2010) and *cough* (p 2050) Examination reveals some *cyanosis wheezing respiration* a prolongation of the *expiratory phase* some bulging of the chest wall diminished respiratory excursion a note of *hyperresonance* and relatively distant breathing in proportion to the chest size

With increase in the disturbance the patient becomes cyanotic and dyspnea is constant *Oxygen unsaturation* results from inefficient and incomplete gas exchange between alveolar air and capillary blood Cough is invariably present it aggravates the dyspnea and in turn results from the shortness of breath With bronchiectatic change the *sputum* becomes increased in amount and of a foul odor *Hemoptyses* (p 2058) occur when the bronchial wall becomes ulcerated

With long standing emphysema the appearance of the patient is characteristic There is an *increased kyphosis* of the dorsal spine The *ribs* assume a more horizontal position raising the sternum upward and forward the anteroposterior diameter of the chest tends to equal the transverse diameter so that the general shape is that of a *barrel* the chest moves but slightly in respiration and is held in a fixed inspiratory position The diaphragm flattens the sternocleidomastoid and the scaleni contract in ordinary respiration the percussion note is tympanitic breath sounds are distant and the expiratory phase is prolonged Because of the nevitable accompanying chronic bronchitis rhonchi are heard through

Acute Respiratory Inflammation	Acute laryngotracheobronchitis lobar pneumonia or acute pneumonitis Supplement physical examination with sputum tests (p 3719) and x rays of chest Acute tuberculous infiltrations with acid fast bacilli in sputum Pneumonic plague with history of epidemic and isolation of P pestis from sputum
Chronic Respiratory Inflammation	Bronchiectasis Chronic bronchitis Tuberculous pneumonitis Nontuberculous pneumonitis Pulmonary mycosis amebiasis helminthiasis and fusospirillosis Putrid and aputrid pulmonary abscess and necrotizing pneumonia Supplement physical examination with sputum tests (p 3719) bronchoscopy (p 2026) bronchography (p 2061) and x rays of chest Consider induction of artificial pneumothorax (p 2035)
Neoplasm	Benign and malignant tumors of larynx, trachea bronchi and lungs Supplement physical examination with laryngoscopy (p 2024) bronchoscopy (p 2026) and x rays of chest

are transitory and the money expended might better have been invested in an air conditioning apparatus that has greater permanence

Surgical technics aimed at removal of the sternum and freeing of the costal cartilages and ribs thus far have proved futile

Bronchiectasis

In bronchiectasis the bronchi or bronchioles are dilated their walls *are inflamed and thickened* the bronchial secretions are increased in amount drainage is impaired resulting in retention secondary infection and the eventual expectoration of large quantities of purulent sputum

Etiology —Bronchiectasis may be of *congenital* origin but most often it is *acquired* as the result of damage to the wall through a long standing *bronchitis* chronic disease of the *paranasal sinuses* or the operation of those factors which lead to the production of *emphysema* (p 2056) Bronchiectasis follows attacks of *pertussis lobar pneumonia* (p 2171) and *pneumonitis* (p 2185) it is associated with *silicosis* (p 2065) the aspiration of *foreign bodies* (p 2048) *tuberculosis* (p 2200) *atelectasis* (p 2052) from whatever cause and *lung abscess* (p 2214)

Many patients with bronchiectasis are demonstrably *allergic* (p 2096) and this factor may be of great significance in those whose symptoms date back to early life Since the majority of bronchiectatics suffer from chronic paranasal sinusitis there is more than a strong suggestion that the sequence of events may be sinusitis (p 2124) bacterial allergy (p 552) and bronchiectasis

Pathology —Bronchial dilatations may be localized or widespread The involved area may be of variable size and the dilatations may be cylindrical saccular or fusiform Frequent sites for early involvement are the lower lobes in the regions of the costophrenic and cardiophrenic angles The disease is unilateral in 60 per cent of cases and the *left lower lobe* is most frequently involved

DIFFERENTIAL DIAGNOSIS OF

Hemoptysis (Blood Spitting)

Summoned to a patient spitting blood the initial problem is to determine whether the bleeding is from the lungs or stomach In arriving at this decision the practitioner may be guided by the following table

	HEMOPTYSIS	HEMATEMESIS
Appearance	Frothy Bright or dark red	Not frothy Dark red or black.
Reaction	Alkaline	Acid
Precedent Symptoms	Tickling in throat cough	Gastric or hepatic disturbances
Later Manifestations	Blood stained sputum	Tarry stools

A difficult situation arises when blood emanating from the respiratory tract is swallowed and then vomited after the stomach has become dilated In essence the patient has had an occult hemoptysis followed by a patent hematemesis Under these circumstances the history clearly indicates the preceding symptoms of respiratory disease which may be demonstrated by physical examination or x ray

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Congenital Anomalies	Cystic disease of lung with characteristic x ray (p 2044)
Circulatory	Local telangiectasis with similar lesions of skin or mucous membranes (p 1119) Pulmonary embolization and infarction particularly with phlebothrombosis of leg vessels (p 1123) Pulmonary congestion in mitral and tricuspid stenosis with characteristic murmurs and changes in cardiac silhouette (p 963) Rupture of aortic aneurysm Vicarious menstruation
Hemorrhagic Diseases	Hemophilia Scurvy with therapeutic response to cevitamic acid (p 1121) Hemorrhagic disease of newborn and other forms of vitamin K deficiency with therapeutic response to menadione (p 1113) Thrombocytopenic purpura leukemia and agranulocytopenias with *characteristic hemograms (p 3704)* Acute capillary toxicosis with cutaneous purpura (p 1112)
Pharmacodynamic	Overdosage with anticoagulants such as dicoumarin and heparin
Trauma and Mechanical Disturbances	Injuries to chest with or without penetration Lung puncture during thoracentesis Aspiration of foreign body Violent coughing during pulmonary emphysema bronchiectasis or pertussis Erosion of vessel in pneumoconiosis Obtain history get chest x ray and prepare for bronchoscopy (p 2026)

CONTINUED

Acute Respiratory Inflammation	Acute laryngotracheobronchitis lobar pneumonia or acute pneumonitis Supplement physical examination with sputum tests (p 3719) and x rays of chest Acute tuberculous infiltrations with acid fast bacilli in sputum Pneumonic plague with history of *epidemic* and isolation of P pestis from sputum.
Chronic Respiratory Inflammation	Bronchiectasis. Chronic bronchitis Tuberculous pneumonitis Nontuberculous pneumonitis. Pulmonary mycosis amebiasis helminthiasis and fusospirillosis Putrid and aputrid pulmonary abscess and necrotizing pneumonia Supplement physical examination with sputum tests (p 3719) bronchoscopy (p 2026) bronchography (p 2061) and x rays of chest. Consider induction of artificial pneumothorax (p 2035)
Neoplasm	Benign and malignant tumors of larynx, trachea bronchi and lungs Supplement physical examination with laryngoscopy (p 2024) bronchoscopy (p 2026) and x rays of chest

are transitory and the money expended might better have been invested in an air conditioning apparatus that has greater permanence

Surgical technics aimed at removal of the sternum and freeing of the costal cartilages and ribs thus far have proved futile

Bronchiectasis

In bronchiectasis the bronchi or bronchioles are dilated their walls are inflamed and thickened the bronchial secretions are increased in amount drainage is impaired resulting in retention secondary infection and the eventual expectoration of large quantities of purulent sputum

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In the involved areas the epithelium is desquamated exposing vessels from which hemorrhage frequently occurs The cilia are lost so that fluid stagnates and accumulates in the bronchial lumen The secretion contains myriads of bacteria and often becomes fetid Surrounding pulmonary tissue may be fibrosed abscessed or gangrenous The noninvolved areas of lung tissue undergo compensatory emphysema

Clinical Manifestations—Bronchiectasis is one of the most frequently encountered pulmonary lesions The majority of patients develop herald symptoms before the second decade but the diagnosis is rarely established until late in life if at all

Many examples of bronchiectasis are completely *asymptomatic* Others remain silent for years and then become evident through chronic persistent *cough* with the expectoration of large quantities of fetid *sputum*



A B

Fig 470—Bronchiectasis A Regular chest film B After passive instillation of lipiodol This patient had had respiratory symptoms for ten months marked by cough hemoptysis and weight loss There were a few crepitant rales heard over the left base Repeated sputums were negative for tubercle bacilli Rather marked improvement in symptoms followed bronchoscopic and postural drainage The patient is being closely observed and lobectomy will be performed if any progression is noted

Recurrent attacks of acute respiratory infection occur More than likely these represent exacerbations of infection in the pulmonary tissue adjacent to the bronchiectasis rather than fresh invasions

Sputum—In typical instances the cough is worse in the morning and the patient expectorates large quantities of frothy sputum which layers on standing The upper stratum is frothy there is an intermediate layer of thin turbid greenish pus the bottom of the glass contains thicker pus bacteria fatty acids and crystals of hematoidin *Hemoptysis* (p 2058) occurs in at least half of the manifest cases and may be profuse and recurrent

Sooner or later the patient suffers a deterioration in general health The coughing disturbs sleep and the fetid odor to the sputum and parox

* McCombs Internal Medicine in General Practice

ysms of cough interfere with eating With an emetic cough nutrition is seriously impaired and weight and strength decrease *Hypertrophic pulmonary osteo arthropathy* occurs to a marked degree Its appearance may precede the elicitation of physical signs in the chest

Bronchography—In its early phases bronchiectasis is diagnosed by *bronchography* There are few or no physical signs and the roentgenogram fails to reveal any distinct abnormality In more advanced instances the coincidental bronchial or pulmonary infection gives rise to alterations in percussion and auscultation sounds together with coarse rhonchi and wheezes The physical signs at all times are disproportionately meager in relation to the vast extent of the disease process

Diagnosis—The diagnosis of bronchiectasis is exceedingly difficult Unless the condition is suspected in its early phases before complications have occurred the lesion passes unnoted With suspicion of the presence of a bronchiectasis the patient is referred to the *bronchoscopist* for visual examination and the injection of radiopaque oil for contrast roentgenography In the more fortunate instances the examination reveals an etiologic factor in the nature of a *bronchial adenoma* (p 2075) an unsuspected endobronchial *foreign body* (p 2046) or a *dilatable stenosis* of the lumen Later the diagnosis has only academic importance since by this time the bronchial walls and the surrounding pulmonary tissues have been irrevocably damaged

The sputum is subjected to careful examination by smear and culture *Darkfield microscopy* (p 45) is carried out for demonstration of *spirochetes* *Acid fast stains* (p 52) are made for the discovery of the *tubercle bacillus* direct smears are scrutinized for sulfur granules of *actinomycosis* (p 489) and *cultures* are made for growth of possible culpable bacterial organisms

Many patients with bronchiectasis are erroneously classified as *tuberculous* (p 2200) Repeated failure to demonstrate *tubercle bacilli* in concentrated sputum and the essential lower lobe involvement should clarify the diagnosis

Course—Bronchiectasis is a *progressive disease* which eventually leads to recurrent and fatal *pulmonary infection empyema thoracis* (p 2222) *cor pulmonale* (p 968) *metastatic intracranial abscesses* (p 1468) or *amyloidosis* (p 7) The last is suspected with the development of *hepatosplenomegaly* and *albuminuria*

Treatment—The best efforts of the practitioner are directed toward the *prevention* of bronchiectasis Conscious of the fact that bronchiectasis exhibits its earliest manifestations in the first and second decades infections in the *paranasal sinuses* (p 2124) and evidences of *allergy* (p 547) are vigorously treated Diseased *tonsils* and *adenoids* are removed and free drainage of the sinuses is assured by *lavage* or *operative therapy* Cultures of pus are obtained and *vaccines* are prepared for purposes of immunization

After the establishment of the bronchiectasis operative therapy for the relief of the possible causative chronic sinusitis is less urgent At this stage the removal of a focus cannot be expected to reverse the bronchiectatic condition but it may prevent recurrences of infection and further damage

Prophylactic measures include intensive therapy of bronchospasm resulting from attacks of *asthma* (p 2101), chemotherapy of *fusospirochetal infections* (p 355) of the oropharynx avoidance of aspiration during *general anesthesia* (p 3923) and the prevention of *pertussis* (p 282) by the use of prophylactic immunizations in infancy

Conservative Therapy—Once the bronchiectatic condition has developed conservative therapy is given thorough and adequate trial Often a *prolonged period of bed-rest* as in the treatment of tuberculosis (p 267), is warranted *Inhalations of steam* are effectually combined with *postural drainage* Intensive courses of penicillin (p 106) and/or streptomycin (p 103) merit extended trial The intramuscular injections or deposits should be supplemented by aerosolization (p 2041) or nebulization using either or both antibiotics

Climatic cure and *spa therapy* of bronchiectasis hold no promise At most secondary infection is relieved and external stresses are minimized Inhalations of volatile oil accomplish nothing other than some deodorization of the sputum and instillations and sprays of oil may well add the element of a *lipid pneumonia* (p 2048) to the difficulties already present

Bronchoscopy—Each patient with significant bronchiectasis is entitled to at least one bronchoscopic examination Every so often the practitioner is rewarded in a localized bronchiectasis by the discovery of a remediable endobronchial lesion such as an unsuspected *foreign body* a *bronchial adenoma* (p 2075) or a *dilatable stenosis* (p 2043) However, the enthusiastic endoscopist is not encouraged to carry out a series of *bronchial lavages* nor should he attempt instillations of oil lest a complicating *lipid pneumonitis* (p 2048) be superimposed on the other difficulties

Roentgen Therapy—Roentgen therapy though enthusiastically reported seems of little avail and may cause pleuropulmonary fibrosis

Surgery—Surgical therapy is worth serious consideration in the management of bronchiectasis Since the majority of lesions are predominantly unilateral at least in the beginning the only opportunity for complete cure and prevention of spread resides in the performance of a *partial or complete lobectomy* The skill of the modern thoracic surgeon has reduced the risk of lobectomy to a point where it may justly be considered a procedure of election (p 3996) In a progressive disease of the character of a bronchiectasis the operative hazard seems inconsequential in proportion to the ominous outlook under conservative observation Less formidable methods are merely palliative they include the production of an *artificial pneumothorax* (p 2033) *phrenicectomy* (p 2039) or *extrapleural thoracoplasty* (p 2040) as in the treatment of tuberculosis (p 252)

CHEMICAL INJURIES

The respiratory tract may suffer irritation and injury as the result of exposure to fumes in *industry* and in *gas warfare* The majority of respiratory irritants cause acute distress Exceptions to this rule are observed in the various types of pneumoconiosis (p 2065) where inhalations of coal dust magnesium silicate or silicon give rise to chronic deposition and inflammation with increased susceptibility to the superimposition of *tuberculosis* (p 252)

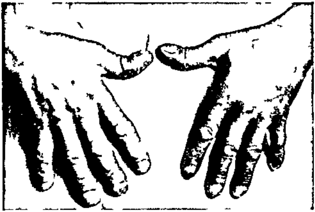


Fig 471 —Hippocratic fingers in bronchiectasis



Fig 472.—Silicosis showing beginning agglomeration in the left lower lobe with resulting secondary emphysema (Dark area just above left leaf of diaphragm)†

Diagnosis —The diagnosis of chemical irritation of the respiratory tract is suggested by the history The further investigation lies within the province of the officials of the Department of Labor and the United States

Major Physical Diagnosis
† McCann in Cecil Textbook of Medicine

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TABLE 129.—CHEMICAL INJURIES OF THE RESPIRATORY TRACT AND THEIR CLINICAL MANIFESTATIONS

Agent or Disease	Etiology	Clinical Manifestations
Ammonia	Occupational	Irritation of upper respiratory tract
Anthracosis	Occupational (coal)	See Silicosis But no unusual susceptibility to tuberculosis
Arsine	Occupational	Sternutation
	War gas	Sternutation
Asbestosis	Occupational (fabricators using magnesium silicate)	See Silicosis
Bromine	Occupational	Lung irritant as chlorine (p 748)
Cadmium	Industry	Respiratory irritant and metal fume fever
Calcium cyanide	Industry	Respiratory irritant
Carbon tetrachloride	Industry	Respiratory irritant
Chlorine	Occupational War gas	Respiratory irritation
Chlorpicrin	War gas	See Chlorine (p 748)
Chromium	Industry	Perforation of nasal septum bronchial ulceration
Diphosgene	War gas	See Chlorine (p 748)
Fluorine	Industry	See Chlorine (p 748)
Formaldehyde	Occupational	Respiratory irritation
Hydrogen sulfide	Occupational	Respiratory irritation
Lewisite	War gas	*Same as mustard (p 750)*
Mercury bichlorid	Accident or suicide	Edema of Larynx
Metal fumes	Industry	Metal Fume Fever (p 7 6)
Mustard	War gas	Vesicant and respiratory irritant
Nitrous fumes	Occupational	Respiratory irritation
Phenol	Accidental ingestion or suicide	Erosions of pharynx and larynx
Phosgene	War gas	See Chlorine (p 749)
Pneumoconiosis	Occupational	Includes asbestosis anthracosis and silicosis (*q v*)
Silicosis	Occupational in miners granite workers sand blasters metalbuffers and pottery workers	Chronic inflammatory giant cell reaction particles carried to tracheobronchial nodes and cause lymphadenopathy nodular fibrosis of interstitial pulmonary tissue radiographs show infiltration and shot nodules may be asymptomatic or causes chronic cough and repeated infections later exertional dyspnea and 60 per cent of fatal instances have tuberculosis
Sulfuric acid	Occupational and accidental or suicidal ingestion	As Phenol (p 7)
Sulfur dioxide	Occupational	Respiratory irritation
Trichloethylene	Industry	As Phosgene (p 748)

DIFFERENTIAL DIAGNOSIS OF

Clubbed Fingers (Hypertrophic Pulmonary Osteo arthropathy)

With clubbing of the fingers (Hippocratic fingers) the terminal phalanges are bulbous and the nails are curved both longitudinally and laterally (Fig 471) The e alterations are due to fibrous thickening of the connective tissues The disturbance is almost always bilateral and symmetrical and may involve the toe as well as the fingers The fundamental disturbance is obviously a change in local oxygenation since it is as ociated almost without exception with cardiorespiratory abnormalities

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Congenital Cardiac Disease	Morbus caeruleus (tetralogy of Fallot Eisen menger complex and pulmonary steno is) Supplement physical examination with x ray of chest for cardiac silhouette (p 963)
Respiratory	*Particularly bronchiectasis fibroid phthis s* putrid lung abscess and malignancies Bron choscopy (p 2026) bronchography (p 2061) sputum tests (p 3719) and chest x rays
Infectious	Subacute bacterial endocarditis with bac teremia (p *1021*)
Miscellaneous	Cirrhosis of liver polycythemia splenic ane mia atrophic arthritis or chronic pancreatitis Order hemogram (p 3704) and liver function tests (p 1947) Examine duodenal contents (p 3726) and stool (p 3728) for pancreatic ferments

DIFFERENTIAL DIAGNOSIS OF

Sneezing (Sternutation)

The reflex act of sneezing is initiated by irritation of the sensory receptors of the trigeminal nerves and the olfactory end-organs The act succeeds in ridding the upper respiratory passages of noxious material and create a pleasurable sensation which accounted for the popularity of the snuffbox in the Age of Elegance

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Allergic	Seasonal and nonseasonal vasomotor rhinitis *and sinusitis Note eosinophils in direct smears* (p 542) Make skin tests for allergens (p 558) Get sinus x rays and refer to special ist for diagnostic lavage
Chemical and Physical Irritants	Gases and vapors in war and industry In *tense heat and cold*
Local Infection	Acute and chronic rhinitis Adenoiditis Hy pertrophic inflammation with polyp formation Perform anterior and posterior rhinoscopy (p 2021)
Systemic Infection	*Measles with exanthem (p 409) Influenza* Pertussis with paroxysmal cough and lym phocytosis
Neoplasm	Benign and malignant intranasal growths Get biopsy Remove polyps (p 2121)
Neurogenic	*Paroxysmal sneezing without local lesion*

MALIGNANCY OF THE NOSE

Malignant lesions within the nose are very rare Suspicion is aroused by the presence of a progressively growing tumor which tends to bleed and ulcerate Specialist consultation is required Biopsy reveals the malignant nature of the neoplasm The method of treatment is determined by the extent of involvement excisable growths are removed surgically inoperable lesions are subjected to roentgen therapy

DENTIGEROUS CYSTS MIXED TUMORS AND CYLINDROMAS OF THE NASAL ACCESSORY SINUSES

Dentigerous cysts mixed tumors and cylindromas occur almost exclusively within the *maxillary sinuses* They obstruct drainage and give rise to chronic inflammation and infection of the lining membrane The patient presents the manifestations of a *chronic paranasal sinusitis* (p 2131)

DIFFERENTIAL DIAGNOSIS OF

Pain in the Nose

Nasal pain due to exudative inflammation is apt to be of great severity since the cutaneous tissues are closely applied to cartilage and bone permitting slight provision for swelling The anatomic peculiarity also explains the perils of nasal infection, which may be complicated by bacteremia rhinogenic meningitis or rhinogenic brain abscess

CLINICAL MANIFESTATIONS	AND DIAGNOSTIC FEATURES
Tegumentary	Erysipelas or herpes with local eruption (p 2110) Furunculosis Abscess of nasal septum visible by anterior rhinoscopy (p 2021)
Neurogenic	Nasociliary neuralgia with hypersensitivity and hyperalgesia but no visible local lesion.
Traumatic	Fracture dislocation or impacted foreign body
Infectious	Acute rhinitis Frontal maxillary or sphenoethmoidal sinusitis Transilluminate x ray and refer to specialist for diagnostic lavage

the fundamental nature of the disturbance is observed only upon close examination of roentgenograms or during the course of a radical operative procedure

Mixed tumors and *cylindromas* are locally malignant and may erode the sinus wall These tumors as well as cysts of the maxillary sinus require removal as soon as secondary infection can be controlled Roentgen therapy is of little benefit

OSTEOMAS OF THE NASAL ACCESSORY SINUSES

Osteomas occur most often in the *frontal sinuses* They appear as slow growing bony masses which may be spongy or dense Symptoms are caused by pressure on surrounding structures and interference with normal drainage Under either of the latter circumstances surgical excision is required

Public Health Service whose assistance is available in the management of all types of occupational and industrial poisoning

Treatment—The important principle in the treatment of respiratory irritation from chemicals involves prevention *Masking* is of great value in industry and in the prevention of damage by the war gases

In the chronic poisonings such as pneumoconiosis tremendous strides have been made in preventive medicine and undoubtedly the future will see much less chronic pulmonary deposition Insufflation or possibly aerosolization (p 2041), with metallic aluminum powder or with powdered aluminum hydroxide may be useful in the prophylaxis and treatment of silicosis

NEOPLASMS

Benign and malignant tumors occur in nasopharynx nasal accessory sinuses oropharynx larynx trachea and bronchi lungs pleura mediastinum chest wall in the region of the acoustic nerve and within the external auditory canal Metastatic deposits from distant malignant lesions frequently become implanted in pleura lungs mediastinum and chest wall

It is the function of the *practitioner* to recognize the presence of a primary growth in its incipiency since early reference to the specialist offers high promise of radical cure The neglected or unrecognized neoplasm whether benign or malignant may become complicated by occlusive symptoms and/or secondarily imposed infection Under such circumstances the lesion may prove incapacitating if not fatal and the opportunity for complete excision or destruction has been permanently sacrificed

CYST OF THE NOSE

A solitary nasal cyst may be observed in the nasal vestibule at the nasolabial junction The lesion is usually *unilateral* and occurs more often in women It probably originates from an embryonic rest and contains clear fluid with a high content of cholesterol

The nasal cyst is differentiated from the more commonly encountered *polyp* in that it is covered with skin and contains characteristic aspirated fluid The lesion requires excision

PAPILLOMA OF THE NOSE

The papilloma of the nose usually arises as a solitary or multiple growth from the paranasal sinuses or the anterior portion of the septum The growth extends in all directions and produces *nasal obstruction* and *facial deformity* *Epistaxes* (p 2123) are frequent and draw attention to the tumor which is firmer and redder than the usual *nasal polyp* invasion of an antrum may cause *loosening of the teeth* as an initial symptom, *proptosis* (p 1575) follows extension into the orbit

The papilloma is firm red and lobulated There is no associated lymphadenopathy but malignant transformation has been encountered

The papilloma is treated by *surgical excision* followed by *cauterization* of the base Recurrences are frequent and may require *roentgen therapy* (p 3796)

the malignancy and the nasopharynx is explored the site of the primary malignancy may be represented by a mere flat depression of the wall with some distortion of the posterior choanae

The proximity of the growth to the eustachian orifice may result in herald symptoms of *deafness tinnitus* or *pain* in the regions of ear or mandible With occlusion of the tube and introduction of secondary infection the presenting manifestations are those of an *otitis media* (p 2144)

Other bizarre representations of the Schminke tumor include *facial neuralgia* (p 1482) *ocular palsies* from erosion of the base of the skull

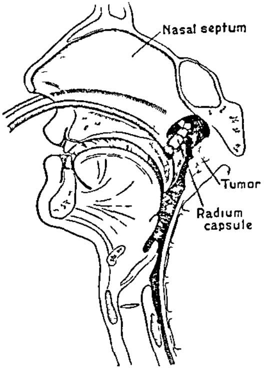


Fig 473—Intracavitary irradiation of cancer of the nasopharynx by a capsule of radium or radon tied in the center of a rubber catheter which is threaded into one nasal cavity and out the other Although this method has the advantage of being simple and requiring no special apparatus it is disadvantageous in that the capsule tends to lie on the upper surface of the soft palate rather than in contact with the tumor itself *

with involvement of the cranial nerves *asymmetry and paralysis of the uvula* due to extension into the palate and recurrent *epistaxis* from ulceration

Diagnosis and Treatment—The diagnosis of the Schminke tumor is established by histologic examination of material obtained by expert nasopharyngoscopy *Treatment* is best conducted by roentgen therapy using the method of Coutard (p 3797) As might be anticipated the results are far from satisfactory

* Martin n ckson and J kson D seases of the Ear Nose and Throat

MALIGNANCY OF THE NASAL ACCESSORY SINUSES

Malignant growths of the sinuses while rare are encountered most often in the *maxillary antrum* The earliest symptoms are those of *nasal obstruction* accompanied by pain in the cheek with radiation to the teeth At times an *external fullness* is noted when the tumor produces bulging or erosion of the anterior antral wall Local involvement of the cervical nodes is common but distant metastases are infrequent local destruction usually is so extensive as to preclude any possibility for operative removal

Roentgen therapy may cause sufficient shrinkage of the growth to per mit a later effort at surgical excision The technical procedure is mutilat ing and must be followed by postoperative irradiation The use of a cautery knife permits wider excision with less danger of extensive hem orrhage

JUVENILE FIBROMAS OF THE NASOPHARYNX

The nasopharyngeal juvenile fibroma arises from the region of the su ture line of the bones of the base of the skull Under the influence of the growth stimulus of puberty the periosteum hypertrophies and the tumor arouses attention Rare benign tumors of the nasopharynx may be *lipomas hemangiomas* and *papillomas*

Clinical Manifestations—The juvenile nasopharyngeal fibroma often produces severe *nasal obstruction recurrent epistaxis* and persistent *infec tion* of the paranasal sinuses Occlusion of the eustachian tube may result in *middle ear infection* with or without subsequent *deafness*

In the early and uncomplicated phase the tumor is felt as a hard nodular *mass* in the nasopharynx With obstruction of the posterior cho anae a frog face is produced by broadening of the nose swelling of the cheeks and exophthalmos

Course—Nasopharyngeal fibromas tend to regress spontaneously after the twentieth year due to the diminished activity of endocrine growth factors

Extension of the neoplasm to the surrounding tissues is productive of alarming consequences The tumor may grow into the nose invading the adjacent sinuses hard palate and inner wall of the orbit it may erode the base of the skull and give rise to a *rhinogenic meningitis* (p 2128), it may break into the orbit and involve the visual apparatus

Diagnosis and Treatment—The diagnosis of the juvenile nasopharyngeal fibroma is established by *biopsy* The lesion is treated by *roentgen therapy* or implantations of *radium* Surgical excision is technically impossible be- cause of the tendency of the growth to extend *into neighboring structures*

THE SCHMINCKE LYMPHO EPITHELIOMA OF THE NASOPHARYNX

The most frequently encountered malignant tumor of the nasopharynx is the *Schmincke lympho epithelioma* which usually arises in the fossa of Rosenmuller posterior to the orifice of the eustachian tube Squamous and transitional cell *carcinomas* also occur in this region as well as *sar comas* and *secondary metastases*

Clinical Manifestations—The Schmincke tumor is productive of decep tive symptoms Attention first may be drawn to the area by the presence of metastases in the *cervical glands* When biopsy of the latter establishes

DIFFERENTIAL DIAGNOSIS OF

Pain in the Throat (Sore Throat)

Despite the many conditions which may give rise to soreness of the throat the diagnosis rarely presents difficulty because of the ease with which the majority of lesions can be recognized by direct inspection For the most part, acute disturbances arise from infection With persistence or recurrence of sore throat however the practitioner must give serious thought to the possibility of the existence of a neoplasm a blood dyscrasia or a local *manifestation of some systemic invasion.*

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Trauma	Foreign body in pharynx or tonsils Erythema or vesiculation due to gases in industry or combat Ingestion of corrosive poisons
Acute Local Inflammations	*Nasopharyngitis Faucial or lingual tonsillitis* Membranous nasopharyngitis or tonsillitis (diphtheria) Ulceronecrotic pharyngitis or tonsillitis (fusospirillosis) Mycotic pharyngitis or tonsillitis (actinomyces or monilia) Local inspection smears and cultures (p 50) Acute or membranous laryngitis Abscess of larynx. Ulcerative laryngitis (tuberculosis) Refer for laryngoscopy (p 2025) Peritonsillar or *retropharyngeal abscess* Thornwaldt's abscess Prepare for incision and drainage (p 2140) Secondary syphilis (mucous patches) with positive darkfield and Wassermann (p 337) Septic sore throat due to streptococcus hemolyticus (p 185) Angioneurotic edema of uvula pharynx or larynx. If no response to epinephrine prepare for scarification.
Chronic Local Inflammation	Hypertrophic or atrophic nasopharyngitis Lingual tonsillitis Faucial tonsillitis Laryngitis Ulcerative laryngitis (tuberculosis) Cystic and polypoid laryngitis Refer for laryngoscopy and get specimens for spreads and biopsy
Systemic Infection	Upper respiratory infection Influenza Cerebrospinal meningitis Measles or scarlet fever with exanthem (p 172) Streptococcemia with positive blood culture (p 53) Infectious mononucleosis with characteristic hemogram and heterophile reaction (p 468) Poliomyelitis with evidences of paralysis and changes in cerebrospinal fluid (p 457)
Neoplasm	Juvenile fibroma or lymphoepithelioma of nasopharynx Malignancy of uvula tonsil epiglottis or larynx. Papilloma of larynx Get biopsy
Neurogenic	Glossopharyngeal neuralgia
Blood Dyscrasias	Agranulocytic angina Acute leukemia Check hemogram (p 3704)

PAPILLOMAS FIBROMAS AND ANGIOMAS OF THE OROPHARYNX

Papillomas fibromas and angiomas are the most frequently observed benign tumors of the oropharynx They may be single or multiple In the latter instance they become pedunculated and resemble a bunch of grapes Most often they are attached to the anterior or posterior pillars of the tonsil the posterior pharyngeal wall or the lingual tonsil They produce *excessive salivation* a sensation of a lump in the throat constant clearing of the throat, due to tickling *stridor* *dysphagia* and some local soreness

The *diagnosis* is established by direct visual examination Nonvascular neoplasms are usually removed with facility by the snare Hemangiomas require *cauterization* or *roentgen therapy*

CARCINOMA OF THE TONSIL

Carcinoma of the tonsil is the most frequent malignant tumor of the pharynx It appears as a nodular ulcerated fungoid growth which pushes the tonsil forward so that it bulges into the oropharynx At this stage the patient complains of *pain* and *dysphagia* and examination reveals the local lesion *Cervical adenopathy* develops early in the course of the disturbance

Diagnosis is established by biopsy *Therapy* consists of protracted irradiation by the method of Coutard and radium implantations into the cervical nodes

CARCINOMA OF THE UVULA

Carcinoma of the uvula is rarely encountered and is usually accompanied by malignant infiltration of the adjacent tonsillar pillars *Roentgen therapy* is the therapeutic approach of choice

CARCINOMA OF THE EPIGLOTTIS

Carcinoma of the epiglottis is slow growing with late metastases Attention is drawn to the lesion by local *pain* *dysphagia* and *blood tinged sputum* Early diagnosis before the cartilage is involved may permit the surgeon to amputate the epiglottis and effect a cure

LYMPHOSARCOMA OF THE TONSIL

Lymphosarcoma of the tonsil appears as a smooth rounded tumor covered by an intact pharyngeal mucosa whose arteries and veins are dilated Rupture of the latter produces frequent local hemorrhages Local glandular metastases may be present and cause the tonsil to protrude into the pharynx

The *diagnosis* is made by biopsy on investigation of the source of bleeding Intensive *roentgen therapy* may accomplish satisfactory control of the neoplasm since cervical node metastases are late in their appearance

BENIGN TUMORS OF THE LARYNX

Benign tumors of the larynx are not infrequent and may be of diverse histological appearance Most commonly the benign tumor of the larynx is *papillomatous* but *adenomas* *cylindromas* *hemangiomas* *lymphangiomas* *congenital cysts* *leiomyomas* and *fibrolipomas* also are encountered

Clinical Manifestations —The characteristic symptom of the laryngeal tumor is hoarseness (p 2160) which may be associated with local discom

Diagnosis.—The diagnosis of cancer of the larynx is made by microscopic examination of tissue obtained by *biopsy*. The practitioner must not be deterred from histologic study by positive serologic tests for *syphilis* (p. 337) or the presence of *pulmonary infiltrations* since malignancy may occur in the *tuberculous* and *syphilitic* as well as those who are free from these infections.

Treatment.—Laryngofissure with resection of the involved vocal cord produces a "cure" of early *intrinsic cancer* of the larynx in 90 to 95 per

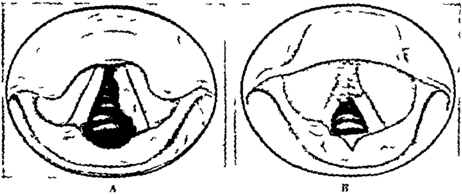


Fig. 474.—Cancer of the larynx. Mirror appearance of lesions suitable for *laryngofissure*. *A*, Lesion involving the *middle third* of the cord. *B*, Lesion in the *anterior commissure*.

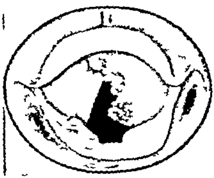


Fig. 475.—Cancer of the larynx. Lesion which has reached not only the anterior but the posterior extremity of the cord and also produced some impairment in cordal motility. *Laryngectomy* is the treatment of choice in such a case.

cent of the afflicted. With the operation of laryngofissure the voice is preserved, the total time of incapacitation is less than three weeks, and if recurrence is encountered a laryngectomy may still be accomplished. If the entire growth has been removed as demonstrated by histological examination of the free margins of the specimen, roentgen therapy is not required. Should there be any question as to the limits of the growth, a full course of *roentgen therapy* is clearly indicated.

fort aggravated by excessive use of the voice With advance in the size of the growth *dysphagia dyspnea* and *reflex otalgia* are encountered Ulceration of the neoplasm results in *blood spitting* which in the instance of the vascular tumors may assume the proportions of a massive *hemoptysis* (p 2058)

Laryngoscopy —On suspicion of the presence of a tumor of the larynx, the patient is referred to the consultant for laryngoscopy Even the expert may be unable to differentiate a *chronic granuloma* resulting from infection with the *tubercle bacillus* from a benign or malignant neoplasm A *biopsy* is required for histological study of the cellular pathology a *bacteriological search* is made for the presence of acid fast bacilli

Treatment —Small *papillomas tend to disappear after* puberty but they may require immediate removal by electrocoagulation and roentgen therapy *Adenomas* and *cylindromas* are best managed by excision and electrocoagulation *Angiomas* and *fibromas* are easily excised at their bases *Large tumors* which offer formidable technical difficulties require removal by laryngofissure

Though there are rarely significant reactions from these simple procedures the practitioner is wise if he insists upon *institutionalization* since postoperative bleeding and edema may require emergency treatment

CARCINOMA OF THE LARYNX

Most malignant tumors of the larynx are *carcinomatous Angiosarcomas* and *sarcomas* which occur as rarities are diagnosed as the result of biopsy

The commonest form of laryngeal cancer is the *intrinsic squamous cell* variety which *arises from the true vocal cords and the ventricular* bands Metastases are infrequent and occur late due to the paucity of lymph drainage from these areas *Extrinsic laryngeal cancer* involves arytenoids epiglottis and other parts of the larynx the lymph nodes are involved early and the spread of the disease is rapid

Clinical Manifestations —Carcinoma of the larynx is more frequent in the *male* and *hoarseness* is its cardinal symptom The presence of the condition requires consideration in any middle aged man who has had a vocal disturbance for more than two weeks With progression of the lesion hoarseness becomes increasingly severe until there is complete *aphonia*

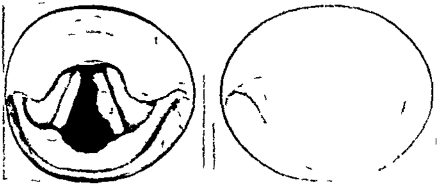
Dysphagia is an early symptom of extrinsic laryngeal cancer but does not appear in the intrinsic variety until the disease is far advanced The presence of local *pain* or *blood spitting* indicates that secondary infection and ulceration have been superimposed Reflex *otalgia* and *dyspnea* are late complaints

Laryngoscopy —On laryngoscopy the *intrinsic carcinoma* appears as a *papillomatous projection* or infiltration on the upper surface or free margin of the *true cords*

The *extrinsic carcinoma* is recognized as a mass arising from *epiglottis aryepiglottic folds arytenoids pyriform sinuses* or *pharyngeal surface* of *cricoid cartilage Cord lag* and interference with free mobility point to considerable local infiltration *fixation of the cord* suggests that the lesion is inoperable

Diagnosis.—The diagnosis of cancer of the larynx ... by ... scopy examination of tissue ... may ... not be determined from ... (p. 55") or the presence of ... may occur in the tuberculous ... from these infections.

Treatment.—Laryngofissure ... produces a "cure" of early intrinsic ...



A

Fig. 4.4—Cancer of the larynx. Mirror appearance of ... Lesion involving the middle third of the cord. B, Le...

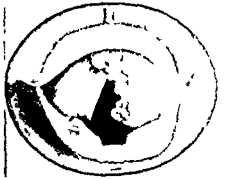


Fig. 4.5—Cancer of the larynx. Lesion which has reached ... not only the ... extremity of the cord and also produced ... Laryngectomy is the treatment of choice in such a case.

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Jackson and Jackson. Diseases of the Ear, Nose and Throat.

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Extrinsic carcinoma of the larynx is not amenable to laryngofissure but requires total excision and/or roentgen therapy The operation of laryngectomy is a mutilating procedure and offers no higher percentage of cures in extrinsic lesions than roentgen therapy alone The presence of metastatic glands and involvement of the base of the tongue attest to inoperability

Roentgen therapy as compared to laryngectomy gives equally favorable results There is no associated permanent loss of voice and no mutilation At times the response of the lesion to roentgen therapy makes possible a secondary surgical procedure These decisions naturally are specialist province and the practitioner must be guided entirely by the judgment of the laryngologist

ADENOMAS OF THE TRACHEOBRONCHIAL TREE

The commonest benign tumor of the tracheobronchial tree is the benign adenoma Cylindromas fibrolipomas myoblastomas and mixed tumors are infrequently encountered

Adenoma of the tracheobronchial tree occurs more often in *females* than in males (in the ratio of 3 to 1) and is usually noted during the third or fourth decade The tumor is nonmalignant but may invade the surrounding parenchyma Histological sections reveal cells of uniform size shape and staining characteristics arranged in solid alveolar formation with a delicate stroma Small specimens taken from an ulcerated edge often look suspiciously malignant and may be erroneously diagnosed as adenocarcinomatous or endotheliomatous

Clinical Manifestations —The clinical manifestations of the bronchial adenoma arise from local irritation ulceration or occlusion The irritative and ulcerative complications produce *cough* (p 2050) with *expectoration* of bright red blood or *hemoptysis* (p 2058)

Asthmatoid Symptoms —When the bronchial adenoma produces an incomplete occlusion the asthmatoid syndrome may be observed The patient or the physician notes localized *sibilant or sonorous sounds* over a single lobe or unilaterally These are often exaggerated by reclining on the silent side and are intensified by effort and forced breathing

Bronchial Occlusion —With complete bronchial occlusion the distal portion of the pulmonary tree undergoes *atelectasis* (p 2052) with the later development of recurrent attacks of *pneumonitis* (p 2185) *bronchiectasis* (p 2059) or *pulmonary suppuration* (p 2214) The diagnosis of the endobronchial lesion can only be suspected by the practitioner whose suspicions are aroused by the sharp localization of the pathologic manifestations in the pulmonary tree

Bronchoscopy —In expert hands diagnostic bronchoscopy is an unpleasant but invaluable technical procedure Since most adenomas are located in the trachea and larger bronchi the *specialist* is enabled to visualize the neoplasm and obtain material for histologic study

The individual tumor usually presents a smooth polypoid surface it is pedunculated and freely movable The bulbous end occupies a wider area than the base and is often directed upward through the expulsive power of the associated cough The mucosa of the bronchus is reflected over the tumor and prominent blood vessels are seen on the surface With

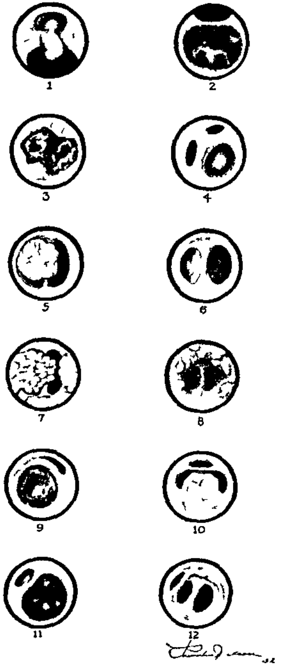


Fig 476—Endobronchial pathology as seen through the bronchoscope*
1 and *2* Endobronchial abscess *3* Bronchiectasis *4* Subacute inflammatory stenosis *5* Lipoma *6* Obstructive granulation tissue in right bronchus *7* Recurring multiple papillomas *8* Multiple osteomas of the trachea *9* Tumor like formation of inflammatory tissues *10* Sessile tumor mass *11* Lobulated tumor *12* Same as *11* after bronchoscopic removal

* Jackson and Jackson Diseases of the Ear Nose and Throat

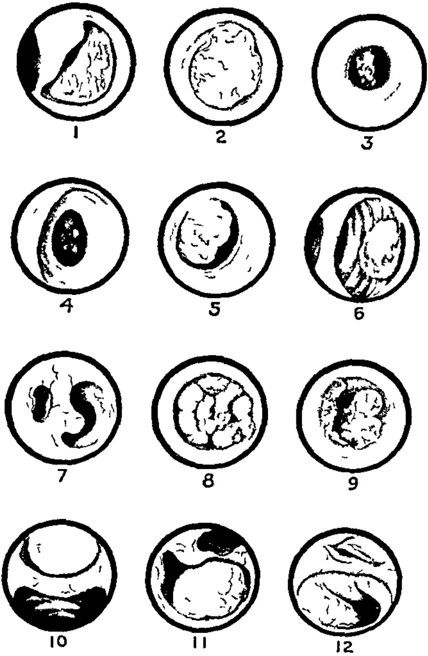


Fig 477—Bronchoscopic views of carcinoma of the bronchus
1 Pedunculated tumor in right bronchus carina thickened anteriorly *2* Tumor of right lower lobe bronchus (squamous carcinoma grade III) *3* Carcinoma originating in bronchial stenosis due to inflammatory consequences of prolonged sojourn of a tooth as foreign body



F 478—Lun tumor See Fi 479

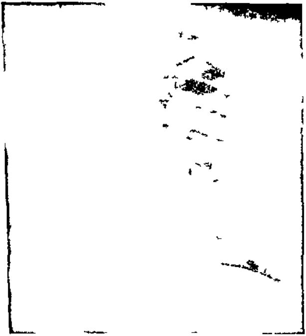


Fig 479—Same case as Fig 478 The end result of pulmon ry surgery in wh h the entire right lung was remo ed Th tumor proved to be bronchogen c carcinoma The dead space in the right ch st was el minated by thoracoplasty Patient rem ns free from respiratory symptoms

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plastic condition may be complicated by the effects of occlusion with peripheral pneumonitis bronchiectasis atelectasis or lung abscess

Treatment —Treatment of the carcinoma of the bronchus in the early stage may be attempted by *lobectomy* or *pneumonectomy* With early diagnosis and complete radical surgery there is some prospect for cure with amazingly little limitation of activity due to reduction in the amount of pulmonary tissue

PRIMARY CARCINOMA OF THE LUNGS

Primary carcinomas of the lung are recognized with increasing frequency The tumors arise from the *bronchial epithelium* and are classified histologically as *squamous cuboidal* (adenocarcinoma) and *small cell* ("oat cell")

Primary lung tumors may arise in any part of the lungs and those of the apex produce characteristic symptoms and signs (p 2081) Spreads by *direct extension involve the hilar and mediastinal nodes Distant metastases* are common and tend to occur early by lymphatic and hematogenous dissemination to the *brain liver adrenals* and *kidneys* The presenting symptoms may be due to cerebral metastases while the primary pulmonary lesion remains small and asymptomatic

Clinical Manifestations —Primary pulmonary carcinoma remains *asymptomatic* for an indefinite period of time The earliest complaint usually is persistent unexplained *cough chest pain* arises later with extension into the bronchi or pleura When ulceration of the bronchial mucosa occurs *blood spitting* or a *hemoptysis* may first bring the patient to his physician The presence of a *pleural effusion* (p 2221) indicates that the neoplasm *has reached the endothelial surface the fluid is characteristically bloody* and may contain *tumor cells Hypertropic pulmonary osteo arthropathy* (p 2878) occurs early and consistently

Main Bronchus Carcinoma—The main bronchus or hilar carcinoma constitutes almost 60 per cent of all of the malignancies of the lung Early signs and symptoms of bronchial irritation and atelectasis are observed there is early lymphatic metastasis to regional nodes and the clinical course is apt to be rapidly fatal Bronchoscopic recognition of the tumor offers little difficulty but unfortunately total extirpation of the growth is not practical because of the extensive lymph node metastases and the local involvement of vital structures

Small Bronchus Carcinoma—The small branch bronchus carcinomas *constitute 25 per cent of the entire group* These lesions *may remain* circumscribed or become infiltrative The circumscribed tumors are not visualized bronchoscopically they are amenable to surgical removal in many instances Infiltrative neoplasms extend into the main bronchus where they are seen on bronchoscopy Unfortunately they also produce involvement of neighboring structures and the hilar lymph nodes so that the very feature which renders them visible also renders them inoperable

Parenchymal or Peripheral Carcinoma—The parenchymal carcinomas of the lungs constitute 15 per cent of the total They originate in terminal bronchi and remain circumscribed in the lung field producing only minimal symptoms They are revealed best by *roentgenograms* which show circular or lobulated shadows with distinct limiting borders The tumors are

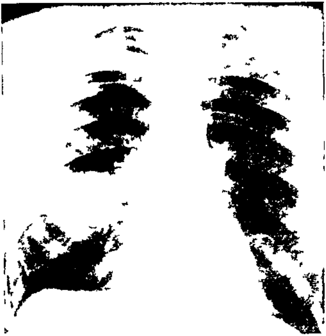


Fig 4"8—Lung tumor See Fig 4"9

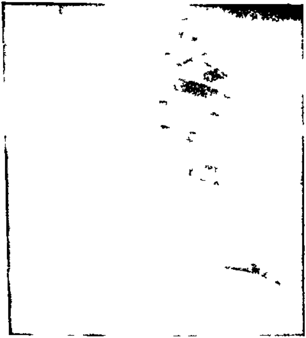


Fig 479—Same case as Fig 4 8 The end result of pulmonary surgery in wh ch the e tire right lung was removed The tumor prove l to be bron ho n c c rcinoma The dead space in the right chest was el mi ated by thoracoplasty Pat ent remains free f om respira tory symptoms

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DIFFERENTIAL DIAGNOSIS OF

Pain in the Chest

Pain in the chest is always a symptom that requires intensive investigation since it may be a manifestation of deep-seated and grave disturbances in pleuropulmonary structures mediastinum, thoracic cage heart great vessels or abdominal viscera

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Cutaneous	Herpes zoster with characteristic vesicles (p 435)
Mammary	Trauma of ill fitting bras ieres Congestion in pendulous breasts Caking of breasts Pre menstrual tension Lactation Chronic cystic disease and abscess formation Fat necrosis with trauma Ulcerating neoplasm
Muscular	Toxic as in influenza Myogelosis with indura tion of muscle sheath Trichinosis with fever puffiness of eyes and eosinophilia
Vascular	Particularly in pulmonary infarction angina pectoris coronary insufficiency and coronary occlusion Check Ecg (p 803) With aortitis aneurysm of aorta and dissection of aneurysm Get x rays in lateral positions From contu sion of heart particularly following injuries by steering wheels
Skeletal	Fractures dislocations inflammations infec tions neoplasms and metastases involving ribs sternum clavicles and vertebrae Best revealed by x rays Subluxation of costo-chondral junctions and sharply localized tenderness
Neurogenic	Crises in tabes dorsalis with pupillary changes and positive serology of spinal fluid (p 1464) Associated with radiculitis particularly in cord tumors with sensory disturbances (p 1430)
Psychogenic	Cardiac neuroses particularly neurocircula tory asthenia In hysteria without organic findings
Pleural	Acute fibrinous pleurisy with friction rub Epidemic pleurodynia with acute febrile disturbance Following pneumothorax with characteristic physical signs (p 2035) Empy ema thoracis particularly revealed by x ray Pleural neoplasms
Digestive	Esophagospasm and cardiospasm Foreign bodies in esophagus Peptic esophagitis Diaphragmatic herniation Give barium meal and consider esophagoscopy (p 1723)
Mediastinal	Acute and chronic mediastinitis Mediastinal emphysema absce s and neoplasm Get x rays in anteroposterior and lateral positions

CONTINUED

Bronchopulmonary	Particularly with laryngotracheobronchitis lobar pneumonia acute and chronic pneumonitis pulmonary abscess pulmonary neoplasm massive collapse tuberculosis helminthiasis and amebiasis of lungs adenoma and carcinoma of bronchus and furunculosis of lung Supplement physical examination with sputum tests (p 3719) bronchoscopy (p 2026) and x rays of chest

not visible by *bronchoscopy* an indication that they are amenable to surgical removal Metastases occur late and are usually hematogenous Occasionally *the herald symptom of the pulmonary neoplasm is caused by a* metastatic deposit in the brain or some one of the bony structures

Superior Sulcus Carcinoma—Tumors of the apex of the lung produce a characteristic symptom complex with localized pain due to erosion of the ribs *brachial neuralgia* (p 2953) and a *Horner s syndrome* (narrowed palpebral fissure enophthalmos and miosis) (p 1400) *Weight loss* and *asthenia* are late signs of an advanced lesion

Diagnosis—The diagnosis of primary pulmonary carcinoma in the stage of operability depends on *roentgenographic investigation* in the presence of minimal symptoms such as persistent cough chest pain or unexplained blood spitting The chance for radical cure has been missed by the time that physical signs are detected or the patient has developed pleural effusion significant atelectasis secondary infection or constitutional symptoms

Treatment—The only successful treatment of primary pulmonary cancer is surgical removal of the affected lobe or lung For inoperable lesions palliative therapy is available and death is the only effectual anodyne

METASTATIC TUMORS OF THE LUNG

Metastatic depositions in the lung may result from *cancers of the breast stomach pelvic organs or thyroid* from *osteogenic sarcomas of bone* from *tumors of the adrenals* or *hypernephromas of the kidney*

Clinical Manifestations—The clinical manifestations of metastatic malignancy in the lungs are usually overshadowed by the symptoms caused by the primary growth An exception to this rule occurs in the *hematogenous miliary dissemination* that *is associated with cancer of the stomach* (p 1814) Without significant digestive distress the patient may present a symptom complex of *hyperpnea cough increasing dyspnea fever* and *loss of weight* The respiratory manifestation together with the radiographic appearances suggest the possibility of a *miliary tuberculosis* (p 257) The sputum however is free from demonstrable tubercle bacilli and the course of the affliction too soon elucidates the hopelessness of the disturbance

Treatment—The treatment of metastatic carcinomatosis of the lungs is palliative The progression of breast implants may be retarded by *roentgen castration* and injections of *androgen* (p 2520)

TUMORS OF THE CHEST WALL

The most frequently encountered tumor of the chest wall is the *cancer of the female breast* elsewhere described (p 2581) Other growths are those

which involve the ribs or scapulas these do not differ from other *neoplasms of bone* (p 2835)

BENIGN TUMORS OF THE PLEURA

Benign tumors of the pleura are rare They include *neurofibromas lipomas* and *fibromas* None of these produces clinical manifestations unless of sufficient size to occupy almost the entire thorax The diagnosis is then established by *aspiration biopsy* or *cytologic examination* of the *pleural fluid* (p 2030)

PRIMARY MALIGNANT TUMORS OF THE PLEURA

Sarcomas and *epitheliomas* of the pleura are rare They tend to reach large size often encapsulating the lung and produce a *hemorrhagic pleural effusion* (p 2032) that contains tumor cells

Pleural tumors produce *local pain* and symptoms of compression and displacement of the underlying lung The *diagnosis* is suspected by the



Fig 480—Dermoid cyst of the mediastinum

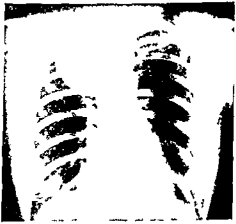


Fig 481—Ganglioneuroma arising from the paravertebral ganglionic chain Operative removal was successful *

roentgenographic appearance and is confirmed by *biopsy* or the finding of *tumor cells* in the aspirated pleural fluid *Treatment* is symptomatic

METASTATIC PLEURAL TUMORS

Metastatic tumors of the pleura are more common than primary tumors A hemorrhagic or serous effusion is noted pleural pain and respiratory embarrassment is marked

Treatment is symptomatic

BENIGN TUMORS OF THE MEDIASTINUM

The benign tumors of the mediastinum may be dermoids fibromas neurofibromas ganglioneuromas or chondromas *Fibromas* are quite rare but bronchiogenic cysts are quite common

* Andrus and Heuer in Christopher Textbook of Surgery

Pathology—The *mediastinal neurofibroma* is one of the more frequent types of solid mediastinal tumor It arises from the sheath of a thoracic spinal nerve is usually present in the posterior mediastinum and produces pain along the intercostal nerves At times the tumor grows out through an intervertebral foramen and simulates a *spinal cord tumor* (p 1430)

Ganglioneuromas originate in the tissues of the sympathetic ganglionic chain in the thorax Primary cartilaginous tumors (*chondroma chondromyxoma* and *chondromyxosarcoma*) originate from the bony cage of the thorax Other rare tumors are *lipomas* and *xanthomas*

Clinical Manifestations—Most mediastinal tumors are *asymptomatic* and are recognized in the course of routine radiography Eventually they produce symptoms due to pressure or encroachment on other mediastinal structures *Dyspnea* and *cough* usually paroxysmal are outstanding symptoms *pain* is variable and *dysphagia* is sometimes noted



Fig 482—Lymphosarcoma of the mediastinal cervical and axillary nodes before treatment



Fig 483—Same case as Fig 482 three months after intensive x ray treatment showing marked reduction in the size of the mediastinal nodes *

Diagnosis and Treatment—The *diagnosis* of a benign tumor of the mediastinum is established by roentgenograms lateral views are taken to localize the mass to the anterior or posterior mediastinum

Benign tumors may be treated expectantly if they produce no symptoms Increase in size suggests malignant transformation and requires *surgical removal* which is often successful

MALIGNANT TUMORS OF THE MEDIASTINUM

Malignant tumors of the mediastinum are uncommon A primary malignant *thymoma* may produce progressive mediastinal compression relieved somewhat by roentgen therapy This type of neoplasm has been observed in *myasthenia gravis* (p 2886) without local symptoms Surgical therapy has been successfully attempted

* Andrus and Heuer in Christopher Textbook of Surgery

Secondary carcinomas tend to obstruct the *superior vena cava* and produce engorgement of the veins of the neck arms and head

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Mediastinum

Disturbances of the mediastinum may re ult in acute emergencies Emphysema resulting from anaerobic infection or penetrating wounds may terminate in suffocation unle s urgent surgical intervention is practiced Gradual shifting of the mediastinum rarely produce symptoms or objective manifestations but acute displacement may result in respiratory or circulatory embarrassment The condition of mediastinal flutter encountered as a complication of thoracic surgery may terminate fatally probably due to induction of an acute cardiac irregularity such as fibrillation of auricles or ventricles

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Ipsilateral Displacement	With massive collapse of lung and other types of atelectasis In association with pleural or pulmonary fibrosis Supplement physical examination by chest x rays
Contralateral Displacement	With hydrothorax, hemothorax chylothorax and pneumothorax Confirm physical findings by aspiration of pleural cavity (p 2030) With solid tumors of pleura mediastinum or lung Check x rays
Emphysema	Following violent paroxysm of cough in influenza or pertus is probably due to traumatic rupture of bleb With anaerobic infection due to external injuries penetration of tracheobronchial tree false pas age of bronchoscope or rupture of subpleural bleb Note palpable crepitation and crunching cardiac murmur Prepare for emergency incision and drainage to prevent suffocation
Widening	Thymoma Note effect of x ray treatments Neoplasm or cyst Consider exploratory thoracotomy Aortic dilatation or aneurysm Note pulsation and get Wassermann (p 337)
Lymphadenopathy	Infectious mononucleosis with positive blood smears and heterophile reaction (p 466) Tuberculosis with positive skin test and rapid sedimentation time (p 3693) Pertussis with paroxysmal cough and lymphocytosis Blood dyscrasias or Hodgkin s disease with characteristic blood or marrow smears (p 1043) Meta tases with evidence of primary tumor elsewhere

ACOUSTIC NEURINOMAS

See p 1420

EPITHELIOMA OF AURICLE

See p 2113

OSTEOMA OF EXTERNAL AUDITORY CANAL

Osteomas of the external auditory canal are often *asymptomatic* but they may produce marked occlusion impaction with cerumen and sub sequent defects in hearing

The tumor is recognized by its appearance and density *Treatment* is palliative using instillations of oil to prevent obstruction by wax With total occlusion endaural or postauricular removal is necessary

CHAPTER 101

THE RESPIRATORY SYSTEM VASCULAR, NEUROGENIC AND METABOLIC DISTURBANCES ALLERGY

VASCULAR DISTURBANCES

Of the vascular disturbances that affect the respiratory system only *pulmonary hypostasis embolization* and *infarction* are discussed in the present chapter

HYPOSTASIS OF THE LUNGS

Hypostatic pulmonary congestion develops in debilitated individuals who have been confined to bed for long periods of time It may also occur in those who are in coma after relatively briefer intervals The congestion is most intense in the dependent portion of the lungs Inevitably secondary infection is superimposed and *acute pneumonitis* (p 2185) may be a terminal event

Clinical Manifestations—Hypostatic pulmonary congestion is notoriously insidious in its development The patient registers no complaint until an advanced stage when *cough* (p 2050) and *dyspnea* are noted Prior to this the physician may have observed slight *cyanosis* minimum *elevations of temperature* readings and *pulse* rates *diminution in breath sounds impairment of resonance* and the appearance of *moist rales*

Treatment—The treatment of hypostatic pulmonary congestion is directed at prevention Patients who are bedridden or in coma must be turned frequently from side to side *Pulmonary ventilation* is encouraged by instructing the conscious patient to take deep breaths and by inhalations of 5 per cent carbon dioxide

On the appearance of appreciable evidences of hypostasis or secondary infection prophylactic therapy with sulfonamides and/or penicillin is instituted (p 106) Inhalations of *oxygen* containing 5 to 10 per cent *carbon dioxide* tend to increase the depth of respiration and relieve cyanosis

PULMONARY EMBOLIZATION AND INFARCTION

The flow of blood in the pulmonary artery or its branches may be obstructed by blood clot air fat globules or a foreign body Whether or not

an infarct develops after occlusion of a pulmonary vessel depends largely on the site of the obstruction in those tragic instances in which the main pulmonary artery is occluded death follows too quickly for the typical pathological changes to evolve

It is difficult to obtain accurate statistics on the incidence of pulmonary embolism and infarctions There can be no question however that they are distressingly frequent not only as postoperative complications but in medical conditions as well

Etiology—Among the causes of pulmonary embolism and infarction are phlebothrombosis and thrombophlebitis of the systemic veins endocar



Fig. 454—Hemorrhagic infarction in lung The obstructing embolus is seen in branches of the pulmonary artery

ditis and pulmonary congestion Phlebothrombosis and thrombophlebitis most commonly follow abdominal or pelvic operations or parturition and involve external or internal iliac veins pelvic veins or deep veins of thigh and calf Shock dehydration cardiac failure tight abdominal binders and heavy sedation contribute to hemoconcentration and local slowing of the circulation Once a thrombus is formed emboli may break off and be carried to the heart and thence into the lungs The result may be massive embolism with immediate death or lesser degrees of pulmonary infarction

While phlebothrombosis and thrombophlebitis are properly emphasized

as postoperative complications they also occur in cardiacs especially the elderly and bedridden and patients suffering from malignancies of the viscera (p 1123)

Pathology—In size infarcts may be minute or so large as to involve a considerable portion of a whole lobe The more readily recognized infarcts are wedge shaped extending to the pleural surface and are dark red in color and firm in consistency Microscopically the vessels within the area are distended with blood and the alveoli are airless and engorged with extravasated red blood cells Infarcts may become secondarily infected with subsequent development of lung abscess

Pulmonary embolism and infarction are more than mechanical obstructions of blood vessels The vascular block probably acts as a trigger mechanism setting off a series of autonomic reflexes affecting rate and rhythm of the heart and possibly also its functional efficiency The electrocardiographic changes that follow pulmonary insults are described elsewhere (p 819) It is conceivable that sudden death following massive pulmonary embolism is partly the result of fatal arrhythmia In the lungs themselves pulmonary arterial obstruction produces strong vagal stimuli which cause bronchoconstriction and increased bronchial secretion leading to *atelectasis* (p 2052)

Clinical Manifestations—The symptoms of pulmonary embolism depend on the size of the obstructed pulmonary vessel If a large embolus passes through the right side of the heart it may lodge in and obstruct the pulmonary artery itself or one of its main branches The clinical picture is dramatic and tragic The patient sits up suddenly gasps for air complains of severe retrosternal pain and becomes intensely cyanotic the pulse becomes very rapid and feeble consciousness is lost and death occurs in 10 or 15 minutes

When the embolus is smaller a lesser branch of the pulmonary artery is obstructed the patient apprehensively complains of sudden sharp pleuritic pain in the side pulse and respirations become more rapid and fever and leukocytosis develop Within twenty four hours cough with blood streaked or frankly bloody sputum is noted The most characteristic physical sign is a friction rub due to the pleuritis overlying the area of infarction Rales or signs of consolidation may or may not develop depending upon the size of the infarcted area

While classical symptoms occur with large infarcts which involve the pleural surface the majority of small infarctions are asymptomatic or produce minor manifestations at most In many patients the only symptoms are cough and fever pleural pain may be entirely lacking and bloody sputum is probably more often absent than present Tachycardia and apprehension are nonspecific but almost invariable accompaniments

A characteristic and unexplained feature of pulmonary infarction is the development of jaundice in an appreciable number of patients particularly cardiacs in congestive failure In such persons the appearance of jaundice unless otherwise readily explained should raise the suspicion of pulmonary infarction

Roentgenograms are ordinarily of little aid in establishing the diagnosis of infarction unless the classical wedge shaped lesions are seen More often the shadows which are demonstrable cannot be distinguished from those produced by pneumonitis or atelectasis both of which may be present in association with infarction

Course—The subsequent course depends on the severity of the original insult the general condition and the number of recurrent attacks of em

bolism The occurrence of a succession of small infarcts may prove fatal to a patient with cardiac disease while another patient with an otherwise normal cardiovascular status may survive When there are multiple in farcts from successive and repeated emboli the outlook is grave unless the source of the embolization can be eliminated When the pleural surface is involved by a large infarct pleural fluid often develops in considerable quantity The fluid is generally clear and poor in cells but it may be bloody

Diagnosis —If the factors which produce pulmonary embolism are borne in mind the diagnosis should not be difficult Massive pulmonary embol ism must be distinguished from coronary thrombosis (p 983) and mas sive collapse of the lungs (p 2053) pulmonary infarction may be confused



Fig 485 —Infarcts in the right lower lobe The patient had hypertension and at nec ropsy three weeks after the roentgenogram was made mural thrombosis of the right auricle and the remains of pulmonary infarcts were found

with atelectasis (p 2052) and post operative pneumonitis (p 2189) Coro nary thrombosis and massive embolizations are indistinguishable in the acute stages but the differentiation is academic in importance since treat ment in either direction is directed toward alleviation of pain and main tenance of the circulation Later the characteristic electrocardiographic changes (p 819) leave little doubt as to the nature of the pathologic lesion Lesser pulmonary infarctions must be differentiated from post operative pneumonitis and atelectasis In massive atelectasis there is the pathognomonic shift of the mediastinum Atelectasis and pneumonitis occur in the first few postoperative days whereas embolization appears in the second week often after the more fundamental phlebitic lesion is apparent

Treatment —The treatment of pulmonary infarction and embolization

Courtesy of Dr L. G Rigler from Reimann in Cecil Textbook of Medicine

is no longer symptomatic Active measures include surgical interference the use of anticoagulants and prophylactic antibiotic therapy with penicillin

Palliation—When the diagnosis is established the patient is kept at *complete* rest and sufficient *opiate* is administered to relieve chest pain and allay apprehension The reflex disturbances that occur through stimulation of the vagus may be inhibited by the addition of *atropine* to the opiate Injections of *papaverine* (p 3854) and *demerol* (p 3863) which relieve pain and relax muscle simultaneously are of particular value

Surgery—More important than symptomatic treatment is the attack upon the more fundamental process Embolization cannot occur without precedent *phlebothrombosis* or *thrombophlebitis* The latter is attacked through medical and surgical procedures Operative intervention is indicated if the thrombosed vein as in the leg or femoral area is clearly demonstrable Under local or general anesthesia the main vessel and its profunda branch are isolated and incised A glass tube attached to a suction apparatus is introduced into the vein and the clot is removed until there is a free flow of blood the veins are then ligated

A heroic form of therapy in embolization of the main pulmonary artery is the attempt at *embolectomy* This daring procedure has a high operative risk

Heparinization—The medical approach to the problem of thrombophlebitis has been furthered by the introduction of a subcutaneous method of administering *heparin* This substance as elsewhere described (p 1050) renders the blood almost incoagulable within a few moments and may maintain this fluid state for several days Anticoagulant therapy may be relied upon without surgical interference if there are no fresh evidences of embolization

Antibiotic Therapy—Prophylactic antibiotic therapy preferably with penicillin (p 106) is instituted immediately

NEUROGENIC DISTURBANCES

The majority of the neurological disturbances that affect the respiratory and auditory mechanisms are elsewhere described The chapter on the nervous diseases includes descriptions of *Meniere's disease* (p 1486) *sphenopalatine neuralgia* (p 1482) and *facial neuralgia* (p 1482) The present concern is limited to material on the neuroses of the pharynx and larynx paralysis spasm and flutter of the diaphragm

Neuroses of the Pharynx

The sensitivity of the pharynx varies greatly even in normal individuals The patient with an *exaggerated gag reflex* rebels as soon as the physician attempts a local examination others have complete *anesthesia* of the pharynx The majority of hyperesthesias and anesthesias of the pharynx have no significance The latter is usually regarded as an indication of the presence of *hysteria* (p 1353) but this is not necessarily so

The development of anesthesia in a previously sensitive pharynx indicates a probable paralysis of the *glossopharyngeal nerve* (p 1488)

NEUROSES OF THE LARYNX

Neurological disturbances of the larynx are encountered with considerable frequency They may be of *psychogenic* or *organic origin* Anesthesia spasm and paralysis are observed

ANESTHESIA OF THE LARYNX

Anesthesia of the larynx may occur as a manifestation of *diphtheria* (p 302) but more commonly it arises from involvement of the *superior laryngeal nerves* or the *vagi*

Since there is an overlapping in the distribution of the superior laryngeal nerves complete anesthesia does not occur unless both nerves are involved centrally as in *tabes dorsalis* (p 1464) *general paresis* (p 1377) *bulbar palsy* (p 1504) or *poliomyelitis* (p 457) Under these circumstances the *cough reflex* is abolished and anesthesia is noted also in the uvula pharynx and tongue An *aspiration pneumonia* may occur unless tube feeding is instituted

HYSTERICAL APHONIA

Hysterical aphonia is accompanied by complete loss of voice or a reduction to a whisper Laryngoscopy may reveal failure of the vocal cords to approximate on attempted phonation This condition differs from an organic laryngeal paralysis (p 2091) when limitation of motion is visible upon coughing laughing and crying

The *treatment* of hysterical paralysis of the larynx is the province of the *psychiatrist* (p 1316)

ORGANIC MOTOR PARALYSES OF THE LARYNX

Organic motor paralyses of the larynx are due to central or peripheral lesions of the recurrent nerves The most common involvement is *paralysis in abduction* Semon s law states a lesion of the recurrent nerve or the medullary center from which it originates affects the *abductor muscles* first the *tensors* second and *adductors* last Hence adductor paralysis rarely occurs independently although it is seen occasionally in syphilis

Anatomy —The recurrent nerves arise from the vagi and run through the neck along the carotid sheaths The *right recurrent nerve* passes around the subclavian artery in the upper part of the thorax and ascends along the esophagus to enter the larynx with the inferior thyroid artery

The *left recurrent nerve* pursues a somewhat longer course passing around the aorta and then ascending along the esophagus to enter the larynx with the left inferior thyroid artery The recurrent nerves may be involved at any portion of their course through the neck or upper mediastinum they may be affected centrally by lesions involving the nucleus ambiguus in which case the lesion is bilateral

Etiology —Paralysis of the recurrent nerves may be traumatic toxic or due to a pressure neuritis Toxic neuropathies occur from poisonings such as *alcoholism* (p 3848) or *plumbism* (p 762) Infectious neuritis is encountered in *diphtheria* (p 302) *typhus* (p 369) *tabes dorsalis* (p 1464) *poliomyelitis* (p 457) *encephalitis* (p 441) and following the injection of *tetanus antitoxin* (p 296) The disturbance may accompany *disseminated sclerosis* (p 1501) *bulbar palsy* (p 1504) *syringobulbia* and *cerebral vascular accidents*

Central paralyses are associated with involvement of the palatal and constrictor muscles of the pharynx Speech is indistinct dribbling is frequent and fluids regurgitate through the nose The uvula remains motionless on phonation or it may be pulled to one or the other side

The left recurrent nerve which pursues a long course in the thorax is particularly subject to a *pressure neuritis* It may be involved in *aneurysms of the pulmonary arteries or aorta* (p 968), with *hypertrophy of the left auricle* as seen in a tight mitral stenosis (p 970) with *pericardial effusions* (p 1008) in *primary carcinoma of the bronchus* (p 2078), and in *lymphadenopathy* following intrathoracic carcinomas and tuberculosis

The commonest cause for traumatic unilateral or bilateral nerve paralysis is injury during the performance of *subtotal thyroidectomy* (p 1214) Whereas a unilateral injury is a mere annoyance the development of a bilateral paralysis may terminate fatally In consequence the practitioner

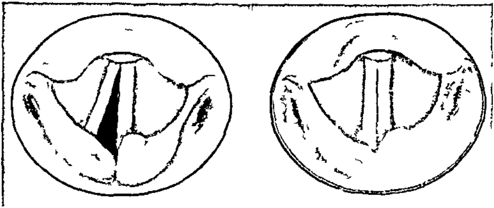


Fig 486—Unilateral midline laryngeal paralysis On inspiration the right cord moves outward normally while the left cord remains in the midline The arytenoid eminence on the paralyzed side is tumbled over forward giving a tumor like appearance on inspiration but it is jostled back into place on phonation by the impact of the active arytenoid Phonation is good in such cases *

should demand a laryngeal examination prior to any operation on the thyroid since a unilateral pressure neuritis may be unobserved preoperatively *A wise precaution during the course of the operative procedure is direct laryngoscopy* after the removal of each lobe If a paralysis is observed an immediate attempt to isolate the torn nerve fibers may be rewarded by a successful repair If the injury is due to accidental ligation of the nerve the ligature can be removed with an excellent prospect of resumption of function

If a unilateral paralysis is observed and correction is not possible the operative *procedure on the opposite lobe is carefully performed to avoid* any possibility of inflicting a bilateral paralysis which may result in asphyxial death

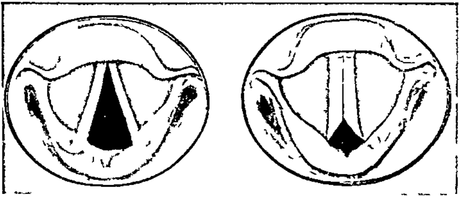
Clinical Manifestations—The clinical manifestations of paralysis of the recurrent laryngeal nerves differ in unilateral and bilateral involvements

Unilateral recurrent nerve paralysis may or may not produce *hoarse*

* Jackson and Jackson Diseases of the Ear Nose and Throat

ness If present the vocal defect is most marked at first but soon becomes less evident when the opposite and uninvolved cord overacts to close the glottic aperture on phonation The voice remains weak and slightly hoarse with a pitch that is somewhat lower than before the injury

With acute bilateral recurrent nerve paralysis there may be urgent *dyspnea* and *asphyxial death* Later the vocal cords become fixed in the median line dyspnea may be severe and yet voice production may well be maintained The midline fixation which usually follows a sudden injury of the nerve is due to the unopposed action of the cricothyroids and the external tensors which are innervated by the superior laryngeal nerves After several days the cords assume the paramedian or cadaveric position leaving an adequate glottic chink in quiet respiration dyspnea is less marked but increases with effort the voice is weak but speech is satisfactory



A B

Fig 437—Two types of bilateral adductor paralysis In *A* the appearance is that of inspiration but on attempted phonation there was no approximation In *B* the triangular glottic silhouette posteriorly is the typical appearance in paralysis of the interarytenoid muscle which normally closes this cartilaginous part of the glottis It is always bilateral It forms part of the image in complete paralysis

Treatment—*Unilateral recurrent nerve paralysis* requires no particular therapy When acute *bilateral palsy* has occurred a tracheotomy is required to prevent asphyxial death After the cords have assumed the paramedian or cadaveric position the tracheotomy may be permitted to close provided that several weeks have elapsed In convalescence the patient must avoid upper respiratory infection even a mild laryngitis may result in repetition of the asphyxial manifestations

In bilateral recurrent nerve paralysis of long duration the King operation may be performed In this procedure one arytenoid and a vocal cord are fixed to a wing of the thyroid cartilage The laryngeal lumen is then maintained at patency without the need of a tracheotomy

LARYNGEAL SPASM

Spasm of the glottis may be encountered in *tabes dorsalis* (laryngeal crises) (p 1464) *tetany* (p 723) and *pertussis* (p 278) it may result

Jackson and Jackson Diseases of the Ear Nose and Throat

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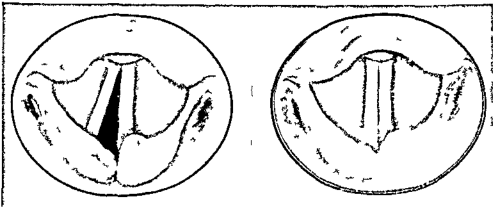


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OTOSCLEROSIS

Otosclerosis is a disease of unknown origin in which there is *bone formation* involving the *capsule of the labyrinth* with frequent *ankylosis of the stapes* The lesion results in progressive *deafness* (p 2019) despite the normal appearance of the *drum membrane* and patency of the *eustachian tubes* The frequency with which the condition is *hereditary* and *familial* suggests that the fundamental disturbance is of metabolic origin

Pathology—The essential pathologic process of otosclerosis in olves absorption of the normal bone of the labyrinthine capsule and its replacement by a new type of bone formation The lesion may affect the capsul in one or more small areas and may be diffuse and symmetrical A point of predilection is the anterior margin of the *oval window* with involvement of th annular ligament Fusion of the footplate of the stapes to the margin of the oval window is the immediate circumstance that results in the hearing defect (p 019)

Clinical Manifestations—The first symptoms of otosclerosis generally appear between the fifteenth and thirtieth years *Females* are affected more frequently and more severely than males The herald manifestation is *tinnitus* (p 2141) which is usually severe and is associated with or followed by *deafness* of varying degree

More than half of the otosclerotics give a family history of nonsuppurative deafness the defect seems to be transmitted through the female

Tinnitus—Tinnitus is present in the majority of instances and varies in severity It may be more disturbing than the hearing loss The noise may be hissing buzzing humming pulsating roaring or thundering

Paracusis Willisiana—A remarkable characteristic of otosclerosis is the ability to hear conversation better in a noisy place such as a train or a subway

Vertigo—Approximately 10 per cent of patients complain of persistent vertigo (p 2020), probably resulting from the otosclerotic foci in the semicircular canals

Deafness—The loss of hearing in otosclerosis is usually bilateral Its onset is insidious it progresses inexorably until the hearing loss is complete It is difficult to ascertain the onset of deafne s but most likely it occurs in early adult life

Amelioration of the complaint seems not to occur but increase in the hearing defect accompanies *pregnancy upper respiratory infection chilling* and *anemia*

Diagnosis—The diagnosis of otosclerosis is *specialist* province The practitioner is impressed by the extent of the hearing defect despite the relatively normal appearance of the drum The specialist confirms the normalcy of the tympanic membrane and demonstrates the patency of the eustachian tubes The *Bezold symptom triad* consists of lengthened bone conduction (p 2017) a markedly negative Rinne test (p 2017) and elevation of the lower limit The presence of paracusis willisiana is most suggestive of otosclerosis

Treatment—Local therapy of otosclerosis is useless and harmful Among the *local measures to be condemned* are intratympanic injections of warm air pilocarpine dionine and pepsin tragus massage probing with electrically driven instruments local exposures to roentgen ray mercury quartz light and diathermy

from local irritation of the recurrent laryngeal nerve by tumors of the neck neoplastic disease of the esophagus inflammation of the regional lymph nodes and cerebral angiospasms

Laryngeal spasm requires immediate sedation using *demerol* (p 3863) or intravenous injections of *papaverine* (p 3854) After the acute episode has been controlled the more fundamental lesion engages the attention of the practitioner

Paralysis of the Diaphragm

Paralysis of the diaphragm results from central or peripheral lesions of the phrenic nerves which may be crushed or avulsed therapeutically in the treatment of *pulmonary tuberculosis* (p 2209)

Unilateral phrenic nerve paralysis produces little or no discomfort Bilateral paralysis which may be the sequel of *poliomyelitis* (p 457) or *multiple sclerosis* (p 1504) seriously impairs respiration Emergency treatment in a respirator (p 462) may be required

Spasm of the Diaphragm

Spasm of the diaphragm may be tonic or clonic The latter produces the common symptom of *hiccough* (p 1933) and is the result of irritation or stimulation of the diaphragm

Tonic contraction of the diaphragm occurs in *epilepsy* (p 1515) *tetanus* (p 294) *strychnine poisoning* (p 3869) *tetany* (p 723) or *rabies* (p 439) If the intercostal muscles are also affected asphyxia may result Heavy sedation may relieve the spasm but treatment of the primary condition is essential

Diaphragmatic Flutter

In diaphragmatic flutter small rapid contractions of the diaphragm occur in intermittent attacks This extraordinary condition may be due to *hysteria* (p 1353) or organic diseases of the nervous system such as produce *hiccough* (p 1933)

The patient is seized with sudden severe *pain* in the lower chest or precordium There may be radiation to the arms simulating an attack of *coronary occlusion* (p 983) Peculiar rapid regular adventitious sounds are heard and irregular movements of the chest and upper abdominal wall are observed On fluoroscopic examination small rapid fluttering movements of the diaphragm are noted in addition to the normal respiratory excursions

There is no satisfactory and consistent *treatment* for the condition which subsides spontaneously Unilateral phrenic nerve block abolishes the disorder for one half of the diaphragm

METABOLIC DISTURBANCES

The respiratory system and the ear rarely present significant manifestations of metabolic derangements Exceptions are noted in the instances of *laryngismus stridulus* (p 2166) related to avitaminosis D and otosclerosis, which is next described

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Useless systemic measures include injections of vaccine administration of endocrine products including thyroid extract estrogen anterior and posterior pituitary preparations and the prescription of large doses of vitamins phosphorus calcium and iodide

Measures of variable *positive value* in prophylaxis include the prevention of upper respiratory infection, the removal of enlarged or infected tonsils and adenoids conservative or operative treatment of paranasal sinusitis and the avoidance of pregnancy unless the woman is willing to risk her hearing for gratification of her maternal instinct

Hearing Devices—Instead of exploiting the hope which springs eternal in the human breast' the patient should be told frankly that the affliction is progressive and that time and effort are better expended upon the purchase of *electrical hearing devices* and perfection of the technic of lip reading

DIFFERENTIAL DIAGNOSIS OF

Hyperacusis (Increased Acuity in Hearing)

Hyperacusis is rarely an isolated presenting symptom Usually it is noted together with other manifestations of hypersensitivity in neurologic disorders and in poisonings with nerve stimulants and convulsants

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Otogenic	Increased acuity of hearing in the midst of loud noises (paracusis Willisiana) In otosclerosis *with progressive deafness and normal drums*
Psychogenic	In hysteria (p 1367)
Neurogenic	In migraine in association with headache In acute and chronic meningitis with characteristic findings in cerebrospinal fluid. In amaurotic family idiocy of infancy with cherry red spots of macula In tetanus following penetrating wounds With trigeminal neuralgia (tic douloureux)
Toxic	Overdosage or poisoning with strychnine or caffeine

Electrical hearing devices have been greatly improved in efficiency and appearance The purchase of the individual apparatus should not be left to chance or methods of sales promotion The tempered advice of an experienced otologist is sought *audiometer readings* are required for assistance in the choice of the device

Surgery—The operation of *fenestration* in most expert hands has given promise of improvement of the hearing defect and relief from tinnitus The procedure is not indicated so long as correction is possible through the use of one of the many electrical hearing devices but must be performed before bone conduction has been excessively reduced

ALLERGIC DISTURBANCES

The reaction of the sensitized respiratory membrane to allergens may result in local or general manifestations The nature of the local tissue

reaction depends in large part upon its texture loose areolar structures with redundant epithelial surfaces exhibit more intense swelling than compact tissues in the bronchi the predominant disturbance is a spasm of smooth muscle A fairly constant characteristic is the outpouring of edema fluid with infiltrations of eosinophils The general considerations and principles of *allergy* are described elsewhere (p 547)

The clinically distinguishable atopies of the respiratory tract include *seasonal rhinitis* (hay fever) *nonseasonal or vasomotor rhinitis allergic paranasal sinusitis allergic pharyngitis allergic laryngitis bronchial asthma* and *eosinophilic pneumonitis* (Loeffler s syndrome)

SEASONAL RHINITIS (HAY FEVER ROSE FEVER POLLINOSIS ATOPIC RHINITIS)

The allergens which usually cause seasonal allergic rhinitis are the *grasses* and *pollens* Those most frequently encountered are giant and small ragweed June grass timothy grass oak, elm birch hickory ash poplar plantain sorrel amaranth artemisia and mountain cedar Maps illustrating the time relationships of pollination in the various sections of the United States suggest the diagnosis in each locality

Clinical Manifestations.—Most sufferers from hay fever give a family history of allergy hence the disturbance is more properly regarded as an atopy (p 552) in contrast to the acquired nonseasonal variety The disturbance starts between the tenth to thirtieth years at a definite season of the year with paroxysms of *sneezing tearing itching nasal obstruction* and a copious *nasal discharge* of a colorless serous secretion There is usually some accompanying *conjunctivitis* and *photophobia* Constitutional symptoms are rare but the patient suffers from anosmia loss of taste and general malaise during his period of disability

Intranasal examination reveals a boggy pale edematous membrane with abundant watery secretion which contains numerous *eosinophils* The turbinal mucosa is often swollen to the extent that it impinges upon the septum Any manipulation causes increased swelling of the turbinate and further discharge

Diagnosis.—The diagnosis of hay fever presents no difficulty The recognition of the specific etiologic allergen rests upon an interpretation of the *skin reactions* (p 555) in the light of seasonal and geographical relationships Many patients show multiple sensitivity oftentimes to substances unrelated to the rhinitis

Course.—The ordinary attack of hay fever lasts throughout the period of pollenation In favorable instances there is then a restoration to normal with recurrence at the next season unless desensitization has been satisfactorily accomplished

Complications.—It is exceptional for hay fever to pursue an uncomplicated course for a long period of time The edema of the membrane invites *secondary infection* and produces occlusive symptoms particularly in the paranasal sinuses Sooner or later the patient develops *infectious paranasal sinusitis* (p 2101) with its threat of sensitization to the bacterial protein as described in the succeeding paragraphs on vasomotor rhinitis (p 2098) Hay fever is also followed in many instances by *bronchial asthma* (p 2101) and *bronchiectasis*

Treatment—The management of hay fever requires specific desensitization palliation during the acute attack and measures of prophylaxis

Desensitization—See p 563

Palliation—During the acute attack of hay fever considerable relief is afforded by topical applications of *vasoconstrictor substances* these include epinephrine 1 1000 amphetamine sulfate 2 per cent neosynephrin 0 25 to 1 0 per cent privine 0 05 to 0 1 per cent and ephedrine 2 to 3 per cent Sympathomimetic activity is also afforded by *inhalations* of amphetamine sulfate and the *oral use* of ephedrine in ⅜ to ¾ grain doses It is a wise precaution to dose the patient liberally with a simple *sedative* such as phenobarbital in ¼ to ½ grain doses every three or four hours while the stimulating vasoconstrictors are being employed

The introduction of effective anti histamine agents (p 565) has improved phenomenally symptomatic treatment of vasomotor rhinitis Pyribenzamine or benadryl in doses of 50 to 100 mg four times daily affords relief in 80 to 90 per cent of patients

Prophylaxis—Those who suffer from the effects of ragweed may migrate to one of the localities in the United States where the weed has been abolished Those who can afford the luxury will obtain great comfort from the installation of an *air conditioning apparatus* with a *filter*

During the free period sufferers from hay fever should have a survey of their upper respiratory passages Attempts should be made to correct mechanical difficulties such as nasal occlusion from a deviated septum or enlarged adenoids and to rid the patient of chronic foci of infection in the tonsils adenoids or paranasal sinuses

Useless Measures—Despite the reports of enthusiasts to the contrary we have observed no specific beneficial effects from the administrations of *calcium viosterol histaminase nonspecific protein injections nitrohydrochloric acid potassium chloride vitamin C* or *hormones* Neither do we favor local treatment to the mucous membrane by *ionization iontophoresis* or *electrocoagulation*

NONSEASONAL VASOMOTOR RHINITIS

Nonseasonal rhinitis like hay fever is an allergic disturbance of the upper respiratory mucous membrane The essential differences are based on the fact that the nonseasonal variety bears no relationship to the time of the year pollination or geographic localization it is not necessarily on a hereditary basis and the offending allergens are of a different quality

Etiology—The most important excitants of nonseasonal vasomotor rhinitis are bacterial proteins inhalants and ingestants

Bacterial Proteins—It is our opinion that bacterial proteins are the most common excitants of nonseasonal hay fever This view is based upon the frequency with which we have observed the condition in patients who have paranasal sinusitis (p 2101) and secondary sensitization to the invading micro organism

Inhalants—Most allergists regard the inhalants as the commonest causes for nonseasonal vasomotor rhinitis The list of those which are frequently encountered includes animal danders from horses cats dogs rab

hits goats cows guinea pigs chickens geese and ducks vegetable powders such as orris rice corn wheat cottonseed kapok flax castor beans hay straw and hops house dust and the spores of various fungi Certain of the inhalants notably orris and rice are found in face-powders and other cosmetics

Ingestants—Vasomotor rhinitis less often arises from the ingestion of certain foods and drugs Among the former are milk eggs wheat fish shellfish nuts chocolate coffee buckwheat celery beans white potato and banana the culpable drugs include quinine acetylsalicylic acid ipecac senna iodine morphine and phenolphthalein

Clinical Manifestations—The clinical manifestations of nonseasonal or perennial hay fever do not differ from those of the pollen variety (p 2097) except in the matter of seasonal recurrence

Course—The course of nonseasonal hay fever is rarely uncomplicated Infection of the involved membrane invariably is encountered exacerbations are frequent and therapy is discouraging

Complications—The complications of nonseasonal vasomotor rhinitis include *bronchiectasis* (p 2059) which in our opinion is exceedingly common *bronchial asthma* (p 2101) and *paranasal sinusitis* (p 2101) In the instance of the latter it is difficult to determine whether the infection precedes the sensitization or vice versa In our opinion it is more likely that paranasal sinusitis precedes allergy due to bacterial bodies in seasonal hay fever it is more likely that the sensitization antecedes the bacterial infection

Diagnosis—The diagnosis of nonseasonal vasomotor rhinitis presents great difficulty The condition is suspected from the appearance of the membrane and the demonstration of eosinophils in the smear To detect bacterial allergy it is necessary to refer the patient to the specialist for sinus lavage Under aseptic precautions a culture is made of exudate this culture is examined for the presence of predominating organisms a bacteria free filtrate is obtained after isolation of possible culprits and skin tests are made with this substance Vaccine therapy may then be administered for purposes of desensitization and immunization

Treatment—The treatment of nonseasonal vasomotor rhinitis has been greatly improved and simplified by the introduction of pyribenzamine or benadryl in doses of 50 to 100 mg four times daily (p 565)

Prophylaxis—Nonseasonal vasomotor rhinitis may be most successfully treated by elimination of the offending allergens The home surroundings are surveyed pillows cats dogs horses furs insecticides drugs and cosmetics are removed from the environs of the patient

Specific Desensitization—Specific desensitization may be carried out in nonseasonal vasomotor rhinitis by the use of injections of protein prepared from skin sensitive inhalants and digestants the technic of preparing and using a bacterial vaccine for desensitization and immunization is elsewhere described (p 563)

Surgery—In a bacterial allergy it is futile to attempt to obtain relief from symptoms by mere injection therapy Injections deposits nebulizations (p 2041) of penicillin or streptomycin are supplemented by intra

nasal treatments (p 2027) or sinus lavage (p 2036) by the specialist Finally if necessary operative procedures merit consideration (p 2038) for the eradication of the infected focus

DIFFERENTIAL DIAGNOSIS OF

Discharge from the Nose

Nasal discharge accompanies irritation of the upper respiratory passages from whatever cause Watery secretion is observed in the early congestive phases of infection, in allergic and chemical disorders and with leakage of cerebrospinal fluid. Thick purulent discharge is usually of infectious origin Bloody or bloodstained material suggests severe damage such as occurs in diphtheria and malignant disease

CAUSES	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Adenoid Enlargement or Infection	Accompanied by persistent nasal obstruction, mouth breathing bad breath, snoring and alterations in facies Perform posterior rhinoscopy (p 2021)
Allergies	Seasonal and nonseasonal rhinitis produce watery rhinorrhea containing eosinophils
Cerebrospinal Rhinorrhea	Leakage of spinal fluid may follow fractures of the base of the skull with communication into the nasal cavity Risk of rhinogenic meningitis and other intracranial complications Check x rays Start anti infective therapy (p 106) and summon neurosurgeon
Local Infections	Acute and chronic rhinitis and sinusitis give rise to watery discharge in congestive phases and to purulent secretion after a few days Get x rays if persistent Chronic discharge with crusting and membrane formation characterizes the more specific invasions in diphtheria syphilis tuberculosis leprosy and glanders Make spreads and cultures for bacteriologic survey (p 52) Darkfield microscopy and Wassermann on suspicion of syphilis (p 337)
Systemic Infections	Nasal discharge constitutes an early manifestation in measles pertussis and influenza Snuffles appears in neonatal syphilis with positive serology Excoriating discharge is observed in diphtheria with organism noted in smears or cultures
Neoplasm	Cysts polyps papillomas and malignant lesions produce persistent nasal discharge often associated with frequent or recurrent epistaxis Biopsy
Mechanical and Chemical Injuries	Foreign bodies produce unilateral putrid or hemorrhagic discharge Idiosyncrasy to or overdosage with, iodide may result in nasal discharge Chemical irritations in war or industry result in rhinorrhea, sneezing and persistent discharge

PHARYNGEAL ULCERATIONS

In allergic individuals small ulcerations are frequently encountered in the pharynx they may also appear in the tonsillar fossa on the posterior pharyngeal wall on the soft palate or the epiglottis

The individual lesions are circular and grayish They usually appear in clumps and are rarely associated with constitutional symptoms Healing occurs without scarring but there is a marked tendency to recurrence

ANGIONEUROTIC EDEMA OF THE LARYNX

The larynx does not ordinarily participate in allergic reactions to the same extent as the remainder of the respiratory passage However angioneurotic edema is a grave manifestation which threatens the life of the afflicted It is rarely the result of bacterial sensitization more often it follows exposure to ingestants and drugs it may also be psychogenic (p 1344)

Clinical Manifestations.—Angioneurotic edema of the larynx usually affects the loose structures the arytenoids the ventricular bands and the aryepiglottic folds The disturbance is announced by the sudden onset of *dyspnea cyanosis* and a sensation of *suffocation* Often there are *urticarial eruptions* elsewhere on the body there may be accompanying *urinary symptoms* such as burning or pain on micturition (p 2325)

Mirror examination of the larynx reveals a pale edema which may spread from the uvula and descend along the fossae to involve the hypopharynx the arytenoids are usually very much swollen they may meet in the midline and close off the laryngeal aperture

Treatment—Angioneurotic edema may yield spectacularly to anti histamine agents (p 565) A subcutaneous injection of 0.5 to 1 0 cc of epinephrine 1 1000 is instantly required a local spray of epinephrine 1 1000 to 1 100 may be combined with 2 to 5 per cent cocaine hydrochloride in an acute emergency The specialist may be required to perform scarification an urgent tracheotomy may have to be done as a life saving measure (p 3908)

ALLERGIC PARANASAL SINUSITIS

The mucous membranes of the paranasal sinuses are often involved with allergic rhinitis The pathologic changes are similar to those observed in the nose There is the same blue edema and eosinophilic infiltrations When edema is marked polyps are formed and these prolapse through the orifices of the sinuses and into the nose

The presence of an allergic disturbance involving the mucous membranes of the paranasal sinuses greatly interferes with drainage An occlusion of the orifice by a prolapsed polyp or an edematous mucous membrane assures retention and perpetuation of infection Allergic paranasal sinusitis is treated in the manner of non seasonal vasomotor rhinitis (p 2099)

BRONCHIAL ASTHMA

Bronchial asthma is a symptom complex in which sensitization to an allergen has resulted in bronchospasm and its attendant difficulties The syndrome is to be distinguished from the paroxysmal dyspnea of cardiac

nasal treatments (p 2027) or sinus lavage (p 2030) by the specialist Finally if necessary operative procedures merit consideration (p 2038) for the eradication of the infected focus

DIFFERENTIAL DIAGNOSIS OF

Discharge from the Nose

Nasal discharge accompanies irritation of the upper respiratory passages from whatever cause Watery secretion is observed in the early congestive phases of infection in allergic and chemical disorders and with leakage of *cerebrospinal fluid* *Thick purulent discharge* is usually of infectious origin Bloody or bloodstained material suggests severe damage such as occurs in diphtheria and malignant disease

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Mechanical and Chemical Injuries	Foreign bodies produce unilateral putrid or *hemorrhagic discharge* *Idiosyncrasy to* or overdosage with, iodide may result in nasal discharge Chemical irritations in war or industry result in rhinorrhea sneezing and *persistent discharge*

gen requires a meticulous survey which relies upon the history the skin tests and the findings in the paranasal sinuses

Treatment—The treatment of bronchial asthma involves exercise of the principles of specific therapy palliation and prevention

Specific Therapy—The specific therapy of an allergic bronchial asthma follows along the lines indicated in the management of *vasomotor rhinitis* (p 2098) whether seasonal or nonseasonal The patient must be protected from exposure to those substances to which he is demonstrably sensitive if this is impossible *desensitization* is carried out by *injection therapy* (p 563) and pyribenzamine or benadryl (p 565) are given for anti histamine effects

Palliation—The symptomatic relief of an attack of bronchial asthma is by no means as simple as is generally represented Chief reliance is placed on the administration of the sympathomimetic amines *Epinephrine* may be injected subcutaneously in doses of 0 25 to 1 0 cc of the 1 1000 solution it may be sprayed in a 1 100 concentration it may be given intramuscularly in an oil base in amounts of 0 2 to 0 3 cc it may be given intravenously as 0 5 to 1 0 cc of 1 10 000 solution As an alternative *ephedrine sulfate* may be taken orally in the doses of ⅜ to ¾ grain usually combined with ¼ to ½ grain of phenobarbital (p 3837) Many patients become dependent upon *asthma cigarettes* which are composed chiefly of *stramonium* (p 3875)

When the simpler measures fail an attempt is made to liquefy mucus by *steam inhalations* *Oxygen therapy* often gives striking relief and many patients keep at hand a tank and a face mask which can be utilized at the first evidences of difficulty

With continuation of distress the therapeutist often succumbs to the temptation of employing a plurality of remedies *Atropine sulfate* is injected in doses of 1/100 to 1/50 of a grain *Aminophylline* is given intravenously by slow injection using 10 cc containing 7½ grains of the drug sedatives are given in increasing dosages using *barbiturates* *chloral hydrate* *bromides* *ether in oil* *paraldehyde* or *avertin with amylene hydrate* 3836) There is a temptation to inject *morphine* for the relief of anguish and anxiety but most allergists strongly oppose this measure since each has observed instances in which the administration of the opiate was followed by a fatal issue Less risk is attendant upon the use of *papaverine* using 1 to 2 grains intravenously or of the newer synthetic *demerol* in 50 to 100 mg doses subcutaneously

If a competent *bronchoscopist* is available a desperation measure in status asthmaticus involves the attempted endoscopic removal of plugs of mucus which may make casts of the bronchial tree In successful instances there is a dramatic relief of urgent symptoms and an impression that life has been saved

Prevention—Following the attack of asthma the patient is allowed a period of convalescence and then is surveyed with the intent of preventing future attacks Anti histamine agents (p 565) are prescribed desensitization is practiced (p 563) and the upper nasal passages are surveyed operative relief is sought for manifestations of occlusion and for chronic infection in the adenoids faucial or lingual tonsils or the paranasal sinuses

disease (*cardiac asthma*) (p 942) and the paroxysms that accompany *pertussis* (p 278) and the attacks of *acute tracheobronchitis* (p 2165)

Etiology—Bronchial asthma usually begins in childhood and occurs in those who have family histories and other evidences of atopy The offending allergen may be any of those responsible for seasonal (p 2097) or nonseasonal vasomotor rhinitis (p 2098) The list includes *inhalants* (p 549) *ingestants* (p 549) *drugs* (p 549) and *bacterial proteins* many patients have multiple sensitivities In certain instances the affliction seems to be a *psychosomatic syndrome* (p 1344) in every asthmatic there are certainly psychogenic overtones

As in nonseasonal vasomotor rhinitis we are strong advocates of the culpability of bacterial proteins nesting in chronically infected paranasal sinuses (p 2131) The presence of this type of sensitization is suggested when other allergens are not incriminated by the skin tests when attacks follow recent acute upper respiratory infections when desensitization with the ordinary substances fails to give relief and when there is demonstrable pathology in the upper respiratory passages

Clinical Manifestations—The acute attack of bronchial asthma often starts with *substernal tightness cough difficulty in breathing prolongation of expiration wheezing* and *gasping* The attack may last for minutes hours or days In the latter instance the syndrome of *status asthmaticus* is one of the most urgent and harrowing complexes with which the practitioner is confronted

The clinical picture of the asthmatic is unforgettable The patient sits upright usually leaning his folded arms on a table in front of him or he may support himself in bed by making a tripod of his buttocks and hands His chest is full respirations are rapid the lungs are hyperresonant the expiratory phase is prolonged musical and coarse rales are heard throughout both lung fields cough is constant and ineffectual Occasionally sticky mucoid sputum is expectorated with some relief of distress There may be some cyanosis the blood pressure and temperature readings are normal but the hemogram occasionally reveals the presence of an eosinophilia

Course—There are two certainties relative to the attack of bronchial asthma One is that the episode will subside the other is that it will recur Repeated attacks inevitably lead to complications

Complications—The asthmatic is prone to develop respiratory and circulatory complications The former include *emphysema* (p 2056) *bronchiectasis* (p 2059) recurrent attacks of *acute pneumonitis* (p 2185) *chronic bronchitis* (p 2168) and any permanent changes in the thoracic cage resulting in a barrel shape The circulatory complications are those of *cor pulmonale* (p 968) and a *generalized arteriosclerosis* (p 981) which may be more marked in the lesser circulation

The relationship of bronchial asthma to chronic paranasal sinusitis presents the same problems as in nonseasonal vasomotor rhinitis (p 2098) We are among those who believe that the upper respiratory focus precedes and is responsible for many instances of bronchial asthma others regard the coincidental finding as circumstantial

Diagnosis—The diagnosis of bronchial asthma should present no difficulty to the clinician The elucidation of the nature of the offending aller

CHAPTER 102

THE RESPIRATORY SYSTEM INFECTIONS OF THE UPPER RESPIRATORY TRACT AND EAR

Physical Diagnosis and Treatment
Rhinophyma
Rhinoscleroma
Nasal Furunculosis
Furunculosis of the External Auditory Canal
Impetigo Contagiosa
Eczema of the External Auditory Canal
Herpes Zoster
Fissure of the Nasal Vestibule
Abscess of the Nasal Septum
Ulcer of the Nasal Septum
Acute Rhinitis (Coryza)
- Membranous Rhinitis

Chronic Hypertrophic Rhinitis
Atrophic Rhinitis (Ozena)
Acute Paranasal Sinusitis
- Acute Ethmoid Sinusitis
- Acute Maxillary Sinusitis
- Acute Frontal Sinusitis
- Acute Sphenoid Sinusitis

Rhinogenic Meningitis
Rhinogenic Brain Abscess
Rhinogenic Cavernous Sinus Thrombosis
Rhinogenic Orbital Cellulitis and Orbital Abscess
Rhinogenic Sepsis
Chronic Paranasal Sinusitis
- Mucocele
- Pyocele
- Pneumatocele
- Cystic Disease

Rhinoscleroma of Paranasal Sinuses
Acute Nasopharyngitis
Chronic Nasopharyngitis
- Atrophic
- Hypertrophic

Mycoses of the Nasopharynx (Thrush)
Acute Adenoiditis
Adenoid Hypertrophy
Thornwaldt's Abscess
Infection of the Eustachian Tube
Otitis Externa
Acute Myringitis
Acute Otitis Media
- Catarrhal
- Purulent
- Mastoiditis
- Labyrinthitis
- Petrositis

Facial Paralysis
Otogenic Meningitis
Otogenic Brain Abscess
Otogenic Venous Complications
Chronic Otitis Media
Acute Lingual Tonsillitis
Chronic Lingual Tonsillitis
Acute Palatine or Faucial Tonsillitis
- Suppurative Cervical Adenitis
- Peritonsillar Abscess (Quinsy)
- Retropharyngeal Abscess
- Parapharyngeal Abscess
- Phlebitis of Internal Jugular Vein

Hyperplasia of the Faucial Tonsils
Chronic Faucial Tonsillitis
Hyperkeratosis of the Tonsils
Calculus of the Tonsils
Acute Epiglottitis
Acute Laryngitis
- Membranous
- Vesicular

Tuberculous and Other Forms of Chronic Laryngitis
Polypoid and Cystic Laryngitis
Rhinoscleroma of the Larynx
Abscess of the Larynx
Perichondritis and Chondritis of the Larynx
Acute Laryngotracheitis (Croup)
Acute Tracheobronchitis
- Ulceromembranous Tracheobronchitis

Chronic Bronchitis

CLINICAL disturbances of the respiratory and auditory structures are most often of infectious origin The management of these lesions is no longer the simple and ineffectual exercise of older days *Roentgenography endoscopy* and *bacteriology* have added great refinement to the diagnostic accomplishments of physical examinations Therapy with anti infective remedies has demonstrated the importance of recognizing each of the di

(p 2131) Enthusiastic psychoanalysts have attempted psychiatric therapy of asthmatics intractable to other forms of therapy Those who suffer from sensitization to inhalants are encouraged to invest in *air conditioning units* with *filters* for use is bedroom or office

Antibiotic Therapy—Whether or not bacterial allergy is demonstrable especially in the upper respiratory passages antibiotic therapy merits intensive and protracted trial Penicillin and/or streptomycin (p 103) are given parenterally by nebulization and by aerosolization (p 2041) in conjunction with pyribenzamine or benadryl for anti histamine effects

Procedures Not Recommended—Among the therapeutic agents and procedures in which we have no confidence are injections of *nonspecific protein autohemotherapy injections of tuberculin* the use of *histamine* and *histaminase* the administrations of *calcium viosterol* and *endocrine products* ingestion of *nitrohydrochloric acid potassium chloride* and *iodide dietotherapy* injections of *dextrose hyperpyrexia* and *insufflations of iodized oil* Neither have we any enthusiasm for the operative procedures such as *sympathectomy* or *paravertebral injections of alcohol Climatic cures* and *spa therapy* accomplish little other than what may be explained on a psychotherapeutic basis

EOSINOPHILIC PNEUMONIA (LOEFFLER S SYNDROME)

Patients who suffer from *vasomotor rhinitis* (p 2098) and *bronchial asthma* (p 2101) experience frequent attacks of *acute pneumonitis* (p 2185) These differ from the infections elsewhere described in that the blood and sputum contain large numbers of *eosinophiles* In the sputum they are often enmeshed in long shreds of mucus which may form casts of the bronchial tree

The condition is managed along the same lines as an acute pneumonitis (p 2197) In convalescence the investigations conducted in the management of bronchial asthma (p 2103) are executed

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Otitis Externa
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  Purulent
  Mastoiditis
  Labyrinthitis
  Petrositis
Facial Paralysis
Otogenic Meningitis
Otogenic Brain Abscess
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TABLE 130—ETIOLOGY, MANIFESTATIONS AND CONFIRMATORY DIAGNOSTIC AIDS IN RESPIRATORY INFECTIONS

Etiologic Organism or Disease	Clinical Manifestations	Confirmatory Diagnosis
Staphylococcus (p 151)	Furuncle of nose or external auditory canal, acute and chronic sinusitis, otitis and mastoiditis, acute tonsillitis, acute laryngotracheitis, acute pneumonitis and furunculosis of lung	Smear and culture of sputum, bacteremia
Streptococcus (p 157)	Erysipelas of nose, acute rhinitis, sinusitis, tonsillitis, pharyngitis, laryngitis, tracheitis, bronchitis, pneumonitis, lobar pneumonia, otitis, mastoiditis and pleuritis, empyema thoracis, septic sore throat, rheumatic pleuritis	Smears and cultures of sputum, bacteremia
D pneumococcus (p 199)	Acute rhinitis, sinusitis, tonsillitis, laryngotracheitis, bronchitis, pneumonitis, lobar pneumonia, otitis media, mastoiditis and pleuritis, empyema thoracis	Smears and cultures of sputum, mouse inoculation, bacteremia, Neufeld typing (p 207)
F typhosus (p [illegible])	Tracheobronchitis, pneumonitis	Bacteremia, agglutination
M tuberculosis (p [illegible])	Ulcer of nasal septum, tonsillitis, laryngitis, tracheobronchitis, pneumonitis, lobar pneumonia, miliary infiltrations, subacute and chronic infiltration, fibrocaseous infiltrations, cavitation, fibrosis, pleurisy, empyema thoracis, mediastinal lymphadenopathy	Sputum smear, roentgenogram, skin tests
C diphtheriae (p [illegible])	Membranous rhinitis, pharyngitis, tonsillitis, laryngitis, sinusitis and laryngotracheitis	Local smears and cultures
K rhinoscleromatis (p [illegible]109)	Rhinoscleroma	Biopsy
H pertussis (p [illegible]78)	Acute rhinitis, sinusitis, laryngitis, sinusitis, tracheobronchitis, pneumonitis, mediastinal lymphadenitis	Cough plate (p [illegible]80)
H influenzae (p 285)	Acute rhinitis, sinusitis, pharyngitis, laryngitis, bronchitis, pneumonitis and otitis	Sputum culture
B anthracis (p 29[illegible])	Necrotizing bronchitis and pneumonitis (wool sorter's disease), lung abscess	Sputum smears and culture
Anaerobes (p [illegible]15)	Putrid lung abscess	Smear and culture
B melitensis (p 314)	Tracheobronchitis, pneumonitis, lobar pneumonia, chronic pneumonitis	Smear and culture, serology
P pestis (p 3[illegible]1)	Pneumonitis, lobar pneumonia	Sputum culture
P tularensis (p 323)	Bronchitis, pneumonitis and lung abscess	Sputum culture
M mallei (p 3[illegible]7)	Ulcer of nasal septum	Culture
B mucosus capsulatus (p 3[illegible]8)	Lobar pneumonia, pneumonitis, empyema thoracis, sinusitis, otitis media, mastoiditis	Smear and culture

TABLE 130—ETIOLOGY, MANIFESTATIONS AND CONFIRMATORY DIAGNOSTIC AIDS IN RESPIRATORY INFECTIONS (*Continued*)

Etiologic Organism or Disease	Clinical Manifestations	Confirmatory Diagnosis
B. leprae (p 2?3)	Ulcer of nasal septum	Smear
T. pallidum (p 331)	Ulcer of nasal septum, interstitial pneumonitis	Serology
Fusospirochetes (p 355)	Ulceronecrotic pharyngitis, tonsillitis, bronchitis and pneumonitis	Smears
Typhus (p 369)	Bronchitis, pneumonitis	Weil Felix (p 3?2)
Rocky Mountain Spotted Fever (p 376)	Bronchitis, pneumonitis	Weil Felix (p 3?2)
Q fever (p ?8?)	Bronchitis, pneumonitis	Weil Felix (p 3?2)
Common cold (p 391)	Rhinitis, sinusitis, pharyngitis, tonsillitis, tracheitis, laryngitis, bronchitis, pneumonitis, otitis media and mastoiditis	
Influenza virus (p 397)		
Virus pneumonitis (p 2188)		
Measles (p 409)	Rhinitis, laryngitis, tracheobronchitis, pneumonitis, otitis, mastoiditis	Eruption
Psittacosis (p 4?3)	Pneumonitis	Sputum culture (p 53)
Ornithosis (p 475)	Pneumonitis	History
Infectious mononucleosis	Acute rhinitis, pharyngitis, tonsillitis and mediastinal lymphadenitis	Hemogram, heterophile reaction (p 466)
Lymphocytic choriomeningitis (p 448)	Pneumonitis	Serology (p 59)
Epidemic pleurodynia (p 403)	Pleuritis	
Actinomycosis (p 489)	Chronic pneumonitis with fibrosis, caseation, cavitation and abscess	Smear and culture
Blastomycosis (p 493)	As in actinomycosis	Smear and culture
Sporotrichosis (p 49?)	As actinomycosis	Smear and culture
Aspergillosis (p 498)	As actinomycosis	Smear and culture
Coccidioidomycosis (p 499)	As actinomycosis but more acute	Smear and culture
Moniliasis (p 50?)	Thrush of pharynx and tonsils	Smear
Amebiasis (p 5?3)	Lung abscess	Smear
Schistosomiasis (p 537)	Lung fluke	Smear
Helminthiasis (p 2213)	Echinococcus Cyst	Smear
Hodgkin's disease (p 1138)	Mediastinal lymphadenitis and chronic pneumonitis	Biopsy

verse invading micro organisms, therapeutic results of a specific nature have been obtained in many conditions that were previously uninfluenced by the best efforts of the practitioner

Physical Diagnosis—There is current tendency to underrate the value of physical diagnosis in investigation of intrathoracic lesions and to place reliance wholly on the results of roentgenograms The astute practitioner has learned that the methods are complementary

Physical diagnosis excels roentgenography in the detection of *alveolar* and *endobronchial abnormalities Subcrepitant and crepitant rales* may be heard in the various types of *pneumonitis* (p 2185) before other demonstrable data are available coarser sounds due to *endobronchial foreign bodies bronchospasm* and *bronchitis* precede the appearance of roentgenographic shadows

Roentgenology—Roentgen diagnosis surpasses the methods of physical examination *in the early detection of the incipient tubercle* areas of *consolidation infiltrations* of acute *pneumonitis* small and moderately large *pulmonary infarcts* collections of *pleural fluid* shifts of the *mediastinum* chronic *pulmonary fibrosis* and *excavations* and *pleural thickenings*

Endoscopy—The skilled examinations of *rhinolaryngologist* and *bronchoscopist* supplement and often exceed in value roentgenological data Radiotranslucent paranasal sinuses may be sites of severe acute infection and radiopaque paranasal sinuses may be free from recent involvement The negative x ray is to be expected in the presence of endobronchial tumors bronchospasm bronchiectasis and severe examples of tracheobronchitis (p 2165) which yield positive findings by direct visual methods

Bacteriology—Bacteriological studies have made clear (*1*) that many organisms may be responsible for any single respiratory infection and (*2*) that each individual organism is capable of producing varied responses While lobar pneumonia is usually the result of a *pneumococcal* invasion it may be also a response to the *streptococcus* the *tubercle bacillus* the *staphylococcus B mucosus capsulatus* or the *bacillus of plague* A wider variety of organisms may produce *acute pneumonitis* (p 2185) This type of pulmonary reaction may follow invasion with *staphylococci strepto cocci pneumococci typhoid bacilli* the *tubercle bacillus* the *H pertussis* the *H influenzae* the *B melitensis* the *B pestis* the *B tularensis* the *B mucosus capsulatus* the various *rickettsiae* (typhus Rocky Mountain Spotted Fever Q Fever) and *viral affections* such as *influenza virus pneumonitis measles psittacosis ornithosis* and *lymphocytic choriomeningitis*

Bacteriological studies reveal that all *chronic pulmonary infections* are not necessarily tuberculous but may be the consequences of fusospirochetosis brucellosis psittacosis ornithosis actinomycosis coccidioidomycosis histoplasmosis or helminthiasis

Anti infective Therapy—Modern anti infective therapy has produced a revision in the practitioner s concept of the management of respiratory infections He has learned that it is his function to deal primarily with the *invading organisms* rather than to direct his entire attention to the site of localization Therapy with sulfonamide (p 88) streptomycin (p 104) or penicillin (p 106) may be indicated whether the susceptible organism has produced a sinusitis a tonsillitis a lobar pneumonia or a pneumonitis The success of the therapeutic endeavor is nullified if the invading or

ganism is antibiotic resistant whether its consequences are observed in the upper respiratory tract or a lobe of the lung

Surgery—The triumphs of specific anti infective therapy in respiratory infections are approached by the perfection of surgical endeavors whether in the upper respiratory passages the ear or within the chest Surgical cures are effected by endoscopy drainage and the removal of infected areas as small as a tonsil and as formidable as an entire lung Palliation is accomplished by many devices such as the collapse therapy in tuberculosis

THE LOCAL MANIFESTATIONS OF RESPIRATORY INFECTION

In the present chapter the local manifestations of infections of the respiratory and auditory structures are described in topographical order In Chapter 103 (p 2171) lobar pneumonia and acute pneumonitis are discussed Chronic pneumonitis furunculosis of the lungs miliary tuberculosis pulmonary amebiasis pulmonary helminthiasis and lung abscess are treated in Chapter 104 (p 2199) and in Chapter 105 (p 2219) are described pleuritis mediastinitis and mediastinal lymphadenitis

RHINOPHYMA

In rhinophyma there is a chronic hypertrophy of the tip of the nose masses of thick skin are formed by the prolonged congestion of the local skin area The condition is most frequent in middle-aged men and is associated with long standing *acne rosacea* (p 3357) and *seborrheal dermatitis* (p 3425)

Treatment which is adopted for cosmetic purposes involves surgical removal of the hypertrophied masses repeated cauterization of the granulations and skin grafting until epithelialization has been completed

RHINOSCLEROMA

Rhinoscleroma is a chronic low grade granulomatous disease caused by the bacillus of scleroma It is most common in Balkan countries and rare in the United States In involves principally the nasal cavities with the production of *chronic granulomatous masses* which show the presence of *Mikulicz s cells* Much less frequently rhinoscleroma affects the larynx and causes *subglottic stenosis* (p 2164)

The *symptoms* are those of nasal obstruction with resultant partial or complete stenosis of the nasal cavity and secondary paranasal sinus infection The *diagnosis* is made by demonstration of the characteristic Mikulicz cell on biopsy *Roentgen therapy* may arrest the progress of the disease

NASAL FURUNCULOSIS

Nasal furuncles arise as *hair follicle infections* and frequently follow acute rhinitis and chronic nasal discharge They produce disproportionately severe *pain* and *tenderness* and may be associated with *malaise* and *fever* The overlying skin of alae nasi and the tip of the nose becomes reddened tense and shiny and there may be associated preauricular lymphadenopathy

Furunculosis involving the nasal orifices may have serious systemic consequences Associated *suppurative phlebitis* may give rise to a *bac*

DIFFERENTIAL DIAGNOSIS OF

Dermatoses of the Nose

Dermatoses of the no e constitute co metic blemishes that cause great concern to sensitive patients Pyoderms present the threat of invasion of venous channels with subsequent bacteremia and intracranial complications

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Acne Rosacea	Persistent redness with acneform lesions and telangiectases Occurs in adults (p 3357)
Acne Varioliformis	Papulopustular lesion in patients beyond the age of 30 No comedones (p 3356)
Acne Vulgaris	Papulopustular affliction of adolescents with oiliness of skin and comedones Tendency to recurrence (p 3358)
Adenoma Sebaceum	Congenital papular lesions of nose often associated with telangiectases (p 3148)
Chilblain	Tense elevated and erythematous lesions with severe burning and itching Follows exposure to cold (p 3173)
Comedones	Blackheads Frequently seen in adolescents with acne vulgaris
Epithelioma	Isolated elevated waxlike papule with tendency to ulceration Usually occurs in males beyond the age of 40 Get biopsy (p 3220)
Erysipelas	Acute streptococcal infection associated with intense pain and systemic manifestations A fiery red lesion with raised advancing border (p 167)
Erythema Simplex	Redne s of nose Usually congenital but may be associated with chronic alcoholism
Furunculosis	Intensely painful acute pyoderm (p 3248) Usually involves skin of ala or hair follicles within nostrils
Impetigo Contagiosa	Pyoderm with crusting lesion (p 3251) Most often encountered in infants and children
Lupus Erythematosus	Persistent irregular patches of redness with dry adherent cales Removal of scales reveals keratotic prolongations into dilated sweat ducts Telangiectases often present Lesion may be solitary or form characteristic butter fly pattern After healing depressed and atrophic macule remains Usually associated with systemic manifestations including endocarditis diffuse vascular lesions and neph ropathy Get biopsy (p 3399)
Lupus Vulgaris	Cutaneous form of tuberculosis with brownish apple jelly papules or nodules May ulcer ate with marked destruction and scar for mation Get biopsy (p 3262)
Rhinophyma	Chronic bulbous hypertrophy of tip of nose Occurs most frequently in middle aged men with acne rosacea and seborrheal dermatitis (p 3357)
Rhinoscleroma	Chronic low-grade granulomatous di ease involving external nose and nasal cavities

CONTINUED

Syphilis (Neonatal)	Seropurulent or sanguineous nasal discharge (snuffles) Usually associated with mucous patches in mouth and other stigmas of infection. Get darkfield examination and Wassermann (p 2787)
Syphilis (Tertiary)	Saddle nose or perforation of septum from breaking down of gumma Occasional gummatous lesion consisting of rounded painless tumor of tip of nose or nasal septum. Get Wassermann and note therapeutic response to iodide (p 608)

teriemia (p 43) and *intracranial lesions* such as *rhinogenic meningitis* (p 2128) *sinus thrombosis* (p 2130) or *brain abscess* (p 2129) These grave potentialities demand excessive zeal in the establishment of the therapeutic program

Treatment —Nasal furuncles are treated with great gentleness since manipulation is apt to spread the infection and initiate an angular vein phlebitis In the early stages it may be possible to abort the inflammatory process by the use of *cold wet compresses* and the local inunction of *penicillin* or *5 per cent sulfathiazole ointment* *Roentgen therapy* (p 3796) may cause a more rapid subsidence or localization of the inflammatory process

When it becomes apparent that suppuration is inevitable applications of *hot saline compresses* favor localization When pointing occurs the *head of the furuncle is nicked* to allow drainage but the area is not squeezed The antibiotic ointment is spread liberally to prevent local dissemination of the infection

Systemic chemotherapy with the *sulfonamides* (p 88) or *penicillin* (p 106) is advised in the early stages as a measure of prophylaxis This precaution may be omitted when the furuncle is sharply localized the condition of the patient satisfactory and constitutional symptoms lacking Prophylactic chemotherapy is merited for the debilitated patients with chronic disease and those who present systemic or local manifestations of more than moderate intensity

With repeated infections a culture is taken and an organism is obtained for the preparation of an *autogenous vaccine* (p 77) Epilation using topical application of *radium* may terminate recurrent crops of furuncles

FURUNCULOSIS OF THE EXTERNAL AUDITORY CANAL

Furuncles of the external auditory canal occur as the result of impaction of *cerumen* *otomycosis* and acute and chronic *aural discharge* It may follow *trauma* from awkward attempts to remove wax and from the pressure of the ear pieces of the stethoscope

There are few conditions more painful than furunculosis of the canal which may be accompanied by such marked *edema* that the lumen becomes completely occluded In most severe instances the swelling spreads to the skin overlying the mastoid and temporal regions suggesting a local osteomyelitis Usually there is an accompanying *preauricular lymphadenopathy* Sy temic manifestations are mild unless complications develop

the latter include *bacteriemia* and *intracranial lesions* as in *nasal* furunculosis (p 2109) Otitis media, strangely enough, does not occur

Treatment —Furunculosis of the external auditory canal is treated in the manner of the nasal prototype Local radium therapy is particularly valuable as a measure of *prophylaxis* since it destroys hair follicles and alleviates the mycosis

IMPETIGO CONTAGIOSA

The implications of nasal and auditory furunculosis apply equally to impetigo contagiosa (p 3251), particularly in the newborn The highly contagious nature of the affliction requires strictest isolation to prevent spread of the infection especially in institutions

ECZEMA OF THE EXTERNAL AUDITORY CANAL

Eczema of the external auditory canal is most often an *otomycosis* The condition is apt to be persistent and obstinate It is associated with intense *itching impaction of cerumen* a tendency to the development of a superimposed *furunculosis* (p 2111) and *secondary dermatitis* from trauma and the overenthusiastic use of irritating drugs and chemicals

The efforts to eradicate this condition include complete removal of cerumen and debris topical applications of 2 per cent *gentian violet* or 1 per cent *thymol* in albolene instillations of *liquid petrolatum* or *castor oil* the strict avoidance of water in irrigations or the daily ablutions Should the condition fail to respond to this program of therapy the insertion of *radium* (p 3796) under expert observation is worthy of consideration

HERPES ZOSTER

Herpes zoster may involve the external auditory canal the ear drum the pharynx or the larynx In each of these situations the condition is suspected by the intensity of *pain* and the *vesicular* nature of the eruption The therapeutic approach is purely palliative it consists of topical applications of local anesthetic solutions such as 5 per cent *cocaine hydrochloride* or 2 per cent *pontocaine*

FISSURE OF THE NASAL VESTIBULE

Fissure of the nasal vestibule occurs in the course of an *acute rhinitis* (p 2114) or results from *trauma* in picking the nose The fissure usually is situated in the angle between the alae nasi and the nasal septum or on the floor of the vestibule It produces pain and marked tenderness over the tip of the nose and is usually covered with crusted secretion

The fissure is treated by removal of the crust *cauterization* with 10 per cent *silver nitrate* and inunction with *petroleum jelly* until healing has taken place

ABSCESS OF THE NASAL SEPTUM

Abscess of the nasal septum often occurs as a result of infection of a *hematoma* The patient notes pain and tenderness of the bridge of the nose Intranasal examination reveals redness and swelling of the nasal septum and partial or complete occlusion of the nasal passage The lesion is often accompanied by some pyrexia

Indications for *prophylactic chemotherapy* (p 106) follow the prin

ciples in *nasal furunculosis* (p 2111) After localization has occurred the septal abscess is *incised* and *drained* If early relief is not obtained degen

DIFFERENTIAL DIAGNOSIS OF

Dermatoses of the Ear

The commoner dermatoses of the ear include frostbite post-auricular sebaceous cysts and the painful furunculosis of the external auditory canal

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Chilblain	Frostbite producing areas of cyanotic edema associated with severe itching and pain
Comedones	Blackheads usually situated within outer portion of external auditory canal, may predispose to furunculosis.
Contact Dermatitis	Usually lobular due to earrings Post auricular from spectacles or hair dye (p 3162)
Epithelioma	Isolated persistent papule with tendency to growth and ulceration More frequent in males beyond the age of 40 (p 3220) Get biopsy
Erysipelas	Characteristic fiery red lesion with indurated advancing border moderate to severe pain and systemic manifestations (p 167)
Furunculosis of External Auditory Canal	Severely painful pyoderm with marked edema which may obstruct external auditory canal and spread over mastoid region and temporal bone (p 2112)
Herpes Zoster	Vesicular eruption producing severe pain (p 435)
Impetigo Contagiosa	Staphylococcal pyoderm with crusting Usually seen in infants and young children (p 3251)
Intertrigo	Usually post auricular due to pressure of spectacles or to associated seborrhea (p 3161)
Keloid	Usually lobular following puncture for ear rings (p 3166)
Lupus Erythematosus	Papular eruption with characteristic adherent scales containing projections on under surface Healing with atrophy Associated with cardiovascular renal manifestations (p 3300) Get biopsy
Lupus Vulgaris	Persistent apple jelly nodules Ulceration rare Healing with scar formation (p 3262) Get biopsy
Otomycosis	Eczema of external auditory canal with local itching discharge and pain (p 2143) Identify fungus in smears
Sebaceous Cysts	Painless tumor usually found in lobular or post auricular region Puncture yields caseous material (p 3208)

eration of the septal cartilage may result in considerable loss of tissue late deformity and perforation

ULCER OF THE NASAL SEPTUM

The commonest cause for ulcer of the nasal septum is *nose picking* The organisms of *tuberculosis syphilis leprosy* and *glanders* are rare etiologic agents In industry the nasal ulcer is seen in workers exposed to the fumes of *chromic* or *sulfuric acids* (p 752)

Nose picker s ulcer is single and lies anteriorly near the floor of the cartilaginous septum *Syphilitic ulcers* may be multiple and tend to in volve the bone of the septum Ulceration of the nasal septum is manifested by the continuous formation of *crusts* and by occasional *epistaxis* (p 2124)

Unless the history clearly reveals the causative mechanism of ulcera tion from trauma or industrial exposure to fumes a *serologic test* should be made *smears* are made from the secretion and material is obtained for *biopsy* Positive serology does not necessarily imply that the local lesion is syphilitic since luetics as well as nonluetics indulge in nose picking The presence of *acid fast bacilli* in stained smears suggests more definitely that the lesion is *tuberculous* or *leprous* and therapy is then directed at the more fundamental systemic infection

Nose picker s ulcer is treated by removal of the crust *cauterization* of the base with 10 per cent *silver nitrate* or *trichloracetic acid* and inunction with *petroleum jelly*

ACUTE RHINITIS (CORYZA)

An acute rhinitis is rarely limited to the lining membranes of the nasal cavity Most often it is associated with a certain amount of *paranasal sinusitis* and *nasopharyngitis*

Etiology —Most but by no means all coryzas are manifestations of the *common cold* (p 391) rhinitis may however be a herald manifestation of meningococcemias (p 208) and the acute exanthems such as *measles* (p 409) *rubella* (p 418) *scarlet fever* (p 171) or *varicella* (p 420)

In vasomotor rhinitis the chronically damaged membrane may become invaded by any one of the bacterial inhabitants of the respiratory tract and the resultant acute inflammatory process is of *streptococcal staphylococcal influenzal pneumococcal* or *viral origin* Recognition of the plural ity of causative mechanisms assumes importance in diagnosis and therapy

Clinical Manifestations —At a conservative estimate the average Amer ican annually suffers two attacks of acute rhinitis from whatever cause With each of these he endures a certain amount of discomfort and his nose discharges for a period of approximately two weeks His total annual expectancy of sneezing sniffling and snuffling is therefore about one month

Phase of Ischemia —The earliest signs of acute rhinitis are due to ischemia of the mucous membrane and a diminution in the amount of nasal secretion The patient notes sensations of tickling and dryness of the nose Inspiration and expiration particularly of cold air become un comfortable experiences and there is frequent *sneezing*

Congestion and Rhinorrhea —Within a short time the dry phase is followed by *rhinorrhea* Thin watery *nasal discharge* drips from the nos trils and causes irritation of the surrounding skin Excessive *lacrimation sneezing stuffiness* and *nasal occlusion* add to the general discomfort At this time local examination discloses redness and turgescence of the mu cous membrane the turbinates meet in the median line and block the

airway the blood vessels of the posterior pharyngeal wall and tonsillar pillars are congested the patient complains of general malaise muscle aches and aprosexia and there is usually an accompanying low grade pyrexia

Mucopurulent Phase—After another twelve to thirty six hours the mucous glands of the nose become very active A *mucopurulent nasal discharge* appears and the nares are totally occluded The mucous membrane which previously could be constricted by instillations of epinephrine and similar preparations now remains resistant to therapy It becomes necessary to breathe through the mouth unless in the lateral recumbent position the upper air passage temporarily clears Vigorous nose blowing during this period is apt to produce fullness and acute *pain in the ears* by forcing infected material through the eustachian tubes (p 2141)

Resolution—At the end of five to six days the signs of the acute purulent stage subside The mucous membrane becomes less congested and appears dull the discharge decreases in amount but increases in its tenacity It is during this phase that plugs or crusts of secretion block the orifices of the paranasal sinuses with resultant retention of secretion and the appearance of complications (p 2116) Progressively in the more favorable instances the membrane returns to normal the secretions dry and there is a tendency to remove crusts by nose picking which may lead to ulceration of the septum (p 2114) or a brisk epistaxis (p 2124)

Membranous Rhinitis—Membranous rhinitis which is usually of *diphtheritic origin* (p 302) is usually *unilateral* and is accompanied by a *blood stained fibrinous discharge* which has a *foul odor* and produces considerable irritation of the adjacent skin Diphtheritic membranous rhinitis may be associated with disproportionately minor constitutional manifestations Its recognition depends upon the astuteness of the practitioner and his willingness to take cultures

Diagnosis—Despite the obvious manifestations of acute rhinitis serious errors in differential diagnosis are encountered with disconcerting frequency In childhood the inflammatory response of the nasal mucous membrane may be a herald symptom of the onset of *measles rubeola varicella* or *scarlet fever* These situations are soon clarified by the appearance of the eruption Acute rhinitis also precedes the development of *influenza* (p 396) *virus pneumonitis* (p 2188) *poliomyelitis* (p 457) *meningococcemias* (p 211) the various types of *encephalitis* (p 441) and *malaria* (p 507)

The majority of patients who complain of repeated colds chronic catarrh or persistent head cold are actually the victims of a secondary rhinitis superimposed upon a *local allergy* (p 547) and/or *chronic paranasal sinusitis* (p 2131) The presence of the *vasomotor rhinitis* (p 2097) is revealed by the history the pallor turgescence and edema of the membrane and clumps of *eosinophils* in the watery nasal secretion When the vasomotor rhinitis is seasonal and due to *pollen* the time relation to pollination leaves little doubt as to the sequence of events In a non seasonal *allergy* (p 2098) the rhinitis has no definite time schedule and the diagnosis is established by a survey of the paranasal sinuses including rhinoscopy (p 2021) transillumination (p 3595) radiography and antral lavage (p 2023) and observation of the therapeutic response to antihistamines (p 565)

Complications—There is probably no such thing as an uncomplicated acute rhinitis the inflammation invariably involves the membranes of the paranasal sinuses the nasopharynx and the pharynx It is only when the other mucous surfaces become more severely involved or remain infected after the rhinitis has subsided that the complication impinges upon clinical consciousness By these criteria the more frequent complications of acute rhinitis include *paranasal sinusitis* (p 2124), *pharyngitis* (p 2137) *tonsillitis* (p 2152), *otitis media* (p 2144) and *pneumonitis* with their sequels The infection may activate a *bronchial asthma* (p 2101) a *bronchiectasis* (p 2059) or a *pulmonary tuberculosis* (p 2199)

Treatment—There is no specific for the prevention or treatment of the common cold The practitioner concentrates on symptomatic measures the prevention of complicating secondary invasions and the thankless task of saving the patient from getting into difficulty as the result of self medication

Self Treatment—Most attacks of acute rhinitis are treated without professional advice from the physician Aside from the money wasted on advertised products of no particular utility much positive damage results from self medication In our own experience we have encountered deaths from agranulocytosis due to aminopyrine acute yellow atrophy of the liver from cinchophen innumerable disturbing responses to salicylates and coal tars serious poisoning from injudicious use of sulfonamides and violent local and systemic reactions consequent to overenthusiastic attempts at intranasal therapy

Prevention—The one effectual method for prevention of the common cold is the avoidance of those who have a cold The virus is usually transmitted from person to person usually by nasopharyngeal secretions While chilling drafts and wet feet may contribute to susceptibility they certainly do not cause an acute rhinitis and at most are subsidiary factors It is not too much to ask any member of a household who develops a cold to wear the inexpensive nose and face masks that can be purchased at any drug store The physician owes it to himself to practice preventive medicine by masking when he has a cold and when he visits a patient with a cold

SULFADIAZINE PROPHYLAXIS—Mass prophylaxis with continued oral doses of sulfadiazine as recommended by the U S Navy during the War has resulted in very disturbing consequences Despite early enthusiasm for this method after a favorable initial period of three months the effectiveness of sulfadiazine prophylaxis became progressively less marked and eventually a major epidemic due to sulfadiazine resistant strains of streptococci occurred Despite these discouraging results in mass experiments prophylactic sulfadiazine therapy is of value in private practice In the presence of an epidemic or when there is heavy exposure from members of the household the administration of 2 gm (30 grains) of sulfadiazine in four divided doses for a period of perhaps a week may offer protection to the very young the very old and those who have chronic or debilitating illness Sulfadiazine prophylaxis is particularly important for children who have suffered attacks of the acute rheumatic syndrome When sulfadiazine is given as a preventive measure it must be administered with the same caution as in the treatment of disease Each dose is accompanied by a teaspoonful of bicarbonate of soda and a full tumbler of water The urine specimens are observed daily and a blood count is done at the end of the first day of treatment and following the termination of the course (p 101)

VITAMIN PROPHYLAXIS—Vitamin advertisements insinuate that their products prevent the common cold but this is not in accordance with our experience There is no harm in taking large doses of vitamins provided that the cost of the medication does not preclude the purchase of household essentials

COLD VACCINE—The administration of cold vaccine by hypodermic mouth or nasal spray represents a bad investment There is only one certainty relative to all these preparations and that is that none of them contains the organism of the common cold Patients who demand all precautionary measures may be given vaccine provided they understand their

physician's lack of faith in this modality The injection of Influenza A and B vaccine has specific value only when the current epidemic of acute rhinitis is due to these strains of *H influenzae* If the invader is any other organism cross immunity cannot be anticipated

SURGICAL PROPHYLAXIS —Patients who have frequent colds should be referred to the rhinologist during a free period At times the correction of nasal obstruction or the successful treatment of a chronic inflammatory process in an accessory nasal sinus may result in greater local resistance to the cold virus

Active Treatment —Active treatment may be initiated in order to abort the upper respiratory infection or to minimize its discomforts and prevent complications In the majority of instances those who think they are developing a cold have a simple nonspecific congestion of the mucous membrane This is a probable explanation for the numerous methods of aborting the common cold using such variegated procedures as drinking a glass of milk containing a drop of iodine ingesting large doses of cevitamic acid or the more happy expediency of getting thoroughly inebriated

DIETOTHERAPY —The patient with the common cold should continue to take the normal diet with normal quantities of fluid There is a popular trend toward the ingestion of large amounts of fluid The Citrus Fruit Growers Association recommends oranges and lemons while the manufacturers of beverages favor alkaline drinks with or without a spot of whiskey or brandy The last undoubtedly makes treatment somewhat pleasanter and perhaps promotes sweating both of which effects may be credited on the positive side of the ledger None of the dietary suggestions nor the fluid prescriptions possesses any specific value If an excessive amount of fluid is to be ingested nothing is superior to the inexpensive product that flows from the tap

ANALGESIC ANTIPYRETICS —The analgesic antipyretics (p 3832) render the common cold more endurable The simplest and most popular prescription is 0 3 gm (5 grains) of acetylsalicylic acid taken with a teaspoonful of bicarbonate of soda and a full glass of water every three or four hours More complicated prescriptions containing several of the analgesic antipyretics with or without caffeine and/or codeine possess little if any virtue beyond that of the simple prescription Those who exhibit sensitivity to acetylsalicylic acid may substitute acetophenetidin or sodium salicylate in similar doses

VASOCONSTRICTORS —During the period of hyperemia and turgescence symptomatic relief may be afforded by the instillation spray or inhalation of a vasoconstrictor substance such as 3 per cent ephedrine 0 1 per cent privine 0 25 per cent neosynephrine or 2 per cent amphetamine sulfate (benzedrine) Patients must be warned that each of these products may produce local irritation and secondary vasodilatation which may result in more pronounced nasal obstruction after the use of the medicament than existed previously The use of inhalers more than three or four times daily may lead to severe nosebleeds

POSTURAL TREATMENT —Postural treatment is sometimes helpful in providing an optimum surface area for the vasoconstrictor After introduction of the vasoconstrictor into one nostril it is often good practice to have the patient lie so that the treated nostril is uppermost After a few moments the airway becomes patent and the medicinal can pass throughout the entire length of the respiratory passage When one side has been treated the other side is managed in similar fashion Usually when the membrane has well shrunken the meatuses fill with secretion which can then be removed by

gentle blowing Patients are cautioned against vigorous nasal snortings and efforts to blow both nostrils simultaneously these practices may result in the introduction of infected material through the Eustachian tube and into the middle ears

STEAM INHALATION —Steam inhalations with or without medication often provide considerable comfort particularly if used five or ten minutes following the local application of the vasoconstrictor After steaming the congested membrane should be protected by the instillation or spray of a few drops of liquid petrolatum Oil treatments are avoided in infants and the enfeebled lest a lipid pneumonitis (p 2048) be initiated

PENICILLIN NEBULIZATION AND AEROSOLIZATION —Until the introduction of penicillin by nebulizer later to be described our experiences with local chemotherapy were most discouraging For many years we have had the impression that silver salts despite their enthusiastic use by patient and rhinologist accomplished little that was good and did much damage to the nasal mucosa Neither have we had happy experiences with topical applications of sulfonamide (p 88) or *tyrothricin (p 103) The sulfonamides* particularly cause local irritation and when absorbed by sensitized patients may give rise to serious toxic manifestations (p 100)

It is our present opinion that nebulization with penicillin (1 cc equals 50 000 units) merits routine trial To be sure the antibiotic agent does not destroy the cold virus hence its benefits must result from elimination of penicillin sensitive organisms capable of the production of secondary invasion and of complications It is our practice to provide the patient with a bottle of 0 1 per cent privine and another containing 500 000 units of penicillin in 10 cc of saline solution The patient is instructed to use the vasoconstrictor drops and at the end of five minutes to expose the membranes to penicillin introduced by nebulizer and not by atomizer The stock bottle of penicillin is kept in the icebox but the patient transfers enough to fill the lower quarter inch of the reservoir of the nebulizer Treatments are conducted every two hours Following the use of the vasoconstrictor the nasal tip of the nebulizer is introduced into one nostril while the other is held closed At the end of a held inspiration the bulb of the nebulizer is forcibly compressed at least five times The patient holds the breath for another few seconds and then exhales through the mouth Each nostril is treated to at least twenty five squeezes of the rubber bulb making a total of fifty deliveries in all Patients who are able to visit the office are given additionally one and preferably two treatments by aerosolization (p 2041)

PHYSIOTHERAPY —Our experiences with physiotherapy in the treatment of rhinitis have been discouraging Whether ultraviolet or infra red radiation or short wave diathermy has been attempted nothing of note has been accomplished in our experience beyond the occasional aborting of the cold as seen without specific therapy We do have a definite feeling however that a prolonged hot tub provides considerable comfort if nothing else While in the tub the patient is encouraged to drink copious quantities of fluid After thorough drying the cold sufferer should take to bed for at least several hours

PURGING —We oppose purging in the management of the common cold It is bad enough to have a stuffy nose without adding to the clinical picture abdominal discomfort an attack of *hemorrhoids and dehydration*

SPECIFICS —Many cold specifics have enjoyed popularity over the years In former days patients used the Dover powder containing ipecac and opium The more modern representation is copavin which is essentially a prescription of codeine and papaverine (p 3859) We have used and pre scribed copavin for many years without being impressed by its specific efficacy We do not object to having patients take copavin provided they notify us and obtain a prescription since the product cannot be dispensed without conforming to the regulations of the narcotic registry We prescribe a tablesponful of the elixir at four hour intervals for nine doses

INUNCTIONS —Amongst other popular and highly advertised products of which we do not approve are the various inunctions sold in stupendous quantities to a gullible public We cannot see where the act of smearing the body with volatile oils mustard and the like constitutes useful therapy However in childhood they provide industry for zealous maternal hands In adult life most of these products are a nasal affront

Summary for Patients—The summary of our instructions to patients afflicted with the common cold is as follows

1 Go home Take a hot bath Get into bed

2 Drink copious amounts of fluid if it makes you feel more comfortable

3 Take your normal diet so that you are not too depleted when the infection has subsided

4 If you have had any fortunate experiences with copavin take tablespoon doses of the elixir at four hour intervals for thirty six hours

5 For symptomatic relief take aspirin phenacetin or any other of the coal tar remedies which you elect, but you must not take aminopyrine

6 Provide yourself with a vasoconstrictor such as privine 0 1 per cent Instil 2 or 3 drops into each nostril at two-hour intervals during the early period of the cold and at four hour intervals later when the secretion is thick If you wish to substitute an inhaler such as is marketed by the manufacturers of benzedrine (amphetamine sulfate) remember that the preparation should not be used more than four times daily

7 Following the use of privine or the inhaler it may be helpful to practice postural drainage by lying first on one side then on the other then on the back, and then with the head hanging down over a bed When secretions are released remove them by gently blowing one nostril at a time Do not blow vociferously and do not blow both nostrils simultaneously

8 Following the clearing of the nose with the vasoconstrictor and the steaming nebulization with a solution of penicillin is worthy of trial To carry out this type of treatment you must purchase a nebulizer We will order the penicillin solution and teach you or some member of your family the technic of introducing the antibiotic agent

9 Please do not use any local application of sulfa drugs in your nose They can do no good and may produce toxic symptoms

10 Wear a mask when you are in contact with other members of your household or those with whom you are associated

11 If your temperature rises above 101 F if you cough if you have pain in the chest face, forehead or ear if you have persistence of symptoms beyond three days spots on your tonsils difficulty in swallowing or a rash you should be seen and examined

12 Do not invest your time or money in the purchase of "cold cures" In our experience there is nothing specific to be obtained from massage manipulation diathermy infra red or ultraviolet treatments bubble baths the smearing on of oils or ointments the use of cold vaccines copious drinking of citrus fruits or violent purging

13 If possible arrange to have office treatments by aerosolization but under any circumstance do not resume your routine until you have been carefully examined

gentle blowing Patients are cautioned against vigorous nasal snortings and efforts to blow both nostrils simultaneously these practices may result in the introduction of infected material through the Eustachian tube and into the middle ears

STEAM INHALATION—Steam inhalations with or without medication often provide considerable comfort particularly if used five or ten minutes following the local application of the vasoconstrictor After steaming the congested membrane should be protected by the instillation or spray of a few drops of liquid petrolatum Oil treatments are avoided in infants and the enfeebled lest a lipid pneumonitis (p 2048) be initiated

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CHRONIC HYPERTROPHIC RHINITIS

Chronic hypertrophic rhinitis with the formation of *polyps* does not occur as an isolated and unique clinical entity It results from repeated or protracted irritations caused by infective allergic chemical or mechanical agents It is the most frequent finding in patients who present themselves as sufferers from chronic catarrh its presence requires that the practitioner seek and discover the more fundamental cause of the affliction

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DIFFERENTIAL DIAGNOSIS OF

Disturbances of Smell

Disturbances of smell may result from abnormalities involving any part of the olfactory pathway from receptor cells in the nasal mucous membrane along the course of the first nerve to the perceptive center in the olfactory gyrus of the cerebrum In the vast *majority of instances simple diminution in smell and even total anosmia result from peripheral disturbances in the nose* Perversions of smell (parosmia and cacosmia) are more often psychogenic or of central origin

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Anosmia	*Acute and chronic rhinitis Seasonal and non* seasonal vasomotor rhinitis Fractures of cribriform plate Injury to olfactory bulb Basilar meningitis and brain tumors in the region of the uncinate lobe Perform anterior rhinoscopy (p 3592) Get smears for eosinophilia (p 542) X ray skull Examine cerebrospinal fluid (p 3734)
Parosmia	In hallucinatory states As aura of epilepsy In hysteria and as an early manifestation of tumor of temporosphenoidal lobe
Cacosmia	Atrophic rhinitis Foul discharge from infected nasal sinus Perform anterior rhinoscopy (p 3592) and get set of sinus films Foreign *body Hysteria*

Etiology—Chronic rhinitis is common in individuals who work in hot *smoky atmospheres* it is more frequently observed in persons who *smoke* to excess particularly those who inhale it occurs in the presence of *septal deviation* (p 2046) with compression of the lining mucosa of the nose and *occlusion of the airway* Less obvious but by no means less frequent factors in chronic hypertrophic rhinitis are chronic infections of the *paranasal sinuses* and the *allergic* types of *vasomotor rhinitis* (p 2098)

Clinical Manifestations—Chronic hypertrophic rhinitis produces *nasal obstruction* and continued *nasal hypersecretion* Thick globules of mucopus collect in the nose drip postnasally into the posterior pharynx and require removal by vigorous nasal *snorting hawking* and *spitting* Expulsion of the material is a noisy disgusting and nauseating experience for all concerned It is worst on arising when it may take the victim a variable length of time to clear his passages The efforts often lead to *gagging* and *vomiting* The senses of *smell* and *taste* are diminished *appetite* is

decreased and general nutrition may suffer in consequence Involvements of the membrane in the vicinity of the eustachian tube produce *tinnitus* and *diminution of hearing*

Examination of the nose in the early phases reveals thickening of the membrane chronic engorgement of the blood vessels and hypersecretion of the mucous glands The application of a cocaine adrenalin solution may shrink the mucosa until it is almost normal in appearance but thick *muco pus* is revealed in the airway and *polypoid degeneration* may become ap parent in the region of the turbinates

When the process is of longer standing the mucous membrane hyper trophies and undergoes polypoid change the submucous layers are edema tous and scarred the periosteum thickens and there is new bone formation in the turbinates Streptomycin (p 104) therapy merits consideration on occasions when coliform organisms are recovered by culture

Diagnosis—The practitioner does not rest content with the discovery of the presence of a chronic hypertrophic and polypoid rhinitis He seeks to determine the underlying cause whether it be a mechanical deflection of the septum chemical irritation from vapors excessive smoking involve ment of the paranasal sinuses or a local allergy Consultation with the specialist is indicated Roentgenograms are made to determine the radio-translucency of the sinuses smears of the nasal secretion are examined for the presence of eosinophils and diagnostic lavage of each antrum is re quired of the rhinologist who should be prepared to make smears and take cultures of the material for purposes of diagnosis and therapy

Treatment—The conservative treatment of chronic hypertrophic rhi nitis is not very satisfactory Exposures to irritant fumes and tobacco smoke are eliminated and efforts are made to relieve the sinus infection by lavage and appropriate topical applications (p 2127)

Palliative measures include the use of *vasoconstrictor sprays or drops steaming* and *instillations* of a protective oil The last is avoided in infancy and the debilitated to avoid the development of a *lipid pneumonitis* (p 2048) Acute exacerbations of the chronic infection are treated in the man ner of an *acute rhinitis* (p 2114)

Anti infective Therapy—With persistent infection or repeated exacer bation intensive and protracted antibiotic therapy merits trial Penicillin (p 106) and/or streptomycin (p 103) are given parenterally and by nebu lization (p 2118) and aerosolization (p 2041) Supplementary use of pyribenzamine is warranted for anti histamine effects (p 565)

Surgery—Surgical therapy usually offers the best possible method for permanent relief The simpler *operative procedures* are resection of the *de viated septum* (p 2046) excision of *polypoid middle turbinates* and the hypertrophied posterior tips of the *inferior turbinates* *polypectomy* and *antrotomy* These technics are executed under local anesthesia They have minimal risk require only brief hospitalization and hold considerable promise if the indications are clear and the operator is skillful The more complicated operations require more deliberation but are worthy of con sideration if discomfort is great and/or *intrathoracic complications* (p 2059) or *focal manifestations* (p 42) are encountered The more formi dable technics include *radical antrotomy* *frontal sinus procedures* and *in tranasal spheno ethmoidectomy* (p 2038)

ATROPHIC RHINITIS (OZENA)

In atrophic rhinitis *mucosal atrophy* and *crust formation* are encountered in the nasal cavity and the nasopharynx As with hypertrophic rhinitis (p 2120) the changes are usually secondary to the continued presence of a more fundamental etiologic factor

Etiology —Though atrophic rhinitis is believed to be a specific disease caused by a specific bacillus it is more likely an end result of chronic suppurative paranasal sinusitis (p 21 4) The influence of *endocrine factors* is illustrated by the greater incidence in females the increased severity of symptoms at the time of puberty and the tendency to abate during pregnancy and after the menopause

Clinical Manifestations —Atrophic rhinitis produces a sense of *nasal obstruction crusting anosmia* and the emission of a *sickening odor* Examination reveals a dry and atrophic mucous membrane with greenish crusts in the regions of the inferior turbinates on the floor of the nasal cavity and the posterior wall of the nasopharynx The paranasal sinuses are usually small and not well pneumatized the ethmoids appear sclerotic with thickened walls

Microscopic examination discloses that the superficial epithelium has lost its cilia and is replaced by a squamous lining Atrophy of the mucous and serous glands and ducts has occurred the venous plexuses of the turbinates *are replaced by fibrotic tissue and the local vessels show the* presence of an obliterative endarteritis

Because of the abnormal quality of the nasal secretion *secondary infection* with saprophytes is invited with a resultant fetid odor Despite the fact that the patient complains of nasal obstruction the airway appears spacious The damage to the mucosa and nerve endings results in *anosmia* and unawareness of the impact of the air on the nasopharynx so that the patient believes he is breathing through the mouth at all times

Treatment —The treatment of atrophic rhinitis is most unsatisfactory The patient may be taught to remove crusts by insufflation of saline solution or irrigation of the nasal passages using a gravity bottle After either of these performances *oil is instilled* into each nostril and sprayed on the posterior pharyngeal wall employing the usual safeguards to prevent the complication of a *lipid pneumonitis* (p 2048)

The endocrine aspects of the disturbance have led to local and systemic administrations of *estrogen* (p 2515) and *anterior pituitary extracts* (p 1152) Other than enthusiastic proponents of these measures there are few who have observed any striking amelioration of symptoms Intensive and protracted therapy with penicillin and streptomycin by injection nebulization and aerosolization (p 2041) merits trial

Surgery —The surgical therapy of atrophic rhinitis is more apt to produce harm than good When the disease is unilateral and in an early stage a *submucous septal resection* to correct nasal obstruction may be of some value With obvious infection and retention in the paranasal sinuses drainage by conservative or operative measures is indicated More extensive operative procedures without definitive indication tend to make the condition considerably more severe Implantations of ivory and bone into the nasal septum have not yielded good results and are not advised

DIFFERENTIAL DIAGNOSIS OF

Bleeding from Nose (Epistaxis)

Nosebleed occurs most often from some local disturbance under which circumstance it has only nuisance value since there is rarely sufficient blood loss to produce secondary anemia Less frequently though more ominously nasal hemorrhage is a local manifestation of a profound systemic disorder The practitioner s immediate problem is control of hemorrhage since he is rarely summoned for brief or minor bleeding Later he is concerned with estimating the effects of the blood loss and discovering the more fundamental etiologic derangement.

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Traumatic	Direct injury Ulceration around foreign body Fracture of nose or of base of skull with characteristic x ray 'Nose-pickers ulcer Irritation from exposure to gas fo fumes in war and industry
Local Infection	With severe acute and chronic rhinitis accessory nasal sinusitis adenoiditis or nasopharyngitis especially diphtheritic Get smears and cultures (p 52)
Systemic Infection	Measles and scarlet fever with characteristic rash (p 172) Pertussis following paroxysmal cough Typhoid fever with bacteremia or rising agglutinin titer (p 225) Neonatal syphilis with positive darkfield and serology
Neoplastic	Benign and malignant intranasal growths Malignant lesions of nasal accessory sinuses Juvenile fibromas of nasopharynx Schmincke lympho epithelioma of nasopharynx Get biopsy
Allergic	Seasonal and nonseasonal rhinitis with eosinophilia
Vicarious Menstruation	Replacing or associated with vaginal bleeding at menstrual time
Cardiovascular renal	With hypertension, congestive failure generalized arteriosclerosis and chronic glomerulonephritis Supplement physical examination and blood pressure readings with blood chemical studies Ecg and fundus examinations (p 3629) Subacute bacterial endocarditis with bacteremia (p 1021)
Hemorrhagic	Hereditary telangiectases with other similar lesions of skin and mucous membranes Scurvy with therapeutic response to cevitamic acid Vitamin K deficiency with therapeutic response to menadione Leukemia anemia polycythemia thrombocytopenic purpura and agranulocytosis with characteristic hemograms Hemophilia
Hepatic	With severe icterus In acute yellow atrophy and hepatic cirrhosis Note changes in tests of liver function (p 1947)

SYMPTOMATIC TREATMENT OF NOSEBLEED

1 Introduce nasal speculum and with good illumination attempt to remove clot and locate point of bleeding
2 Spray nasal cavity with 0 5 per cent pontocaine containing 1 1000 epinephrine
3 If bleeding point is located as for example in anterior portion of nasal septum apply 20 per cent cocaine or 2 per cent pontocaine by means of a pledget of cotton
4 After 10 minutes remove cotton and cauterize with trichloracetic acid or electrocoagulating current
5 Treat eschar with lubricant and caution patient against inflicting *further trauma or blowing nose*
6 If bleeding cannot be controlled prepare to pack nasal cavity with oxidized gauze fibrin foam or topical thrombin inserted between middle turbinate and septum in region of eustachian orifice
7 If there is no visible bleeding in the nasopharynx retain nasal packing for 24 hours moisten with hydrogen peroxide and re move gently
8 If bleeding persists arrange for systemic examination including hemogram bleeding and coagulation times Consider administra tion of vitamins C and K and of transfusion of citrated blood
9 If blood continues to flow introduce No 12 rubber catheter into nostril When visible in nasopharynx tie heavy silk thread around tubing attach to other end of thread a large cotton plug surrounded by gauze and anointed with Vaseline Withdraw nasal catheter through nose so that postnasal plug is applied firmly in nasopharynx Secure position by attaching free end of thread to the skin of the cheek with adhesive tape
10 Remove postnasal plug at end of 12 to 24 hours to prevent the development of a complicating otitis media
11 If bleeding persists summon rhinologist in consultation

ACUTE PARANASAL SINUSITIS

It is inevitable that a certain degree of acute paranasal sinusitis should accompany each attack of *acute rhinitis* (p 2114) The mucous surfaces of the nose and its sinuses are in continuity and each must necessarily reflect the changes that occur in the other Clinical confirmations of the associated sinus involvement are furnished by the frequency with which the sufferer from an acute rhinitis complains of pains behind the bridge of the nose over the cheek and over the eyebrow attesting to involvements respectively of the ethmoids antra and frontals Usually described as *neuralgias* the symptoms arise from accompanying paranasal sinusitis

During the course of the ordinary uncomplicated acute rhinitis the manifestations due to the sinusitis do not impinge upon clinical conscious ness When inflammation of paranasal sinuses overshadows or persists beyond the disturbances due to rhinitis the problem becomes the especial concern of the practitioner

Etiology—A variety of predisposing factors favors the development of paranasal sinusitis These include *overforceful blowing of the nose sneezing diving or under water swimming*

lowing the course of a respiratory infection invasion with a particularly virulent *organism* and *interference with drainage* by a deflected nasal septum an enlarged turbinate a polyp or a plug of mucopus occluding the orifice Acute paranasal sinusitis is more prone to occur in those who suffer *chronic hypertrophic changes* (p 2120) in the mucous membrane as the result of chronic infection or a *local allergy* (p 547)

Systemic precipitants include a general lowering of resistance lack of sleep fatigue chilling or the excessive use of tobacco and alcohol

Clinical Manifestations

The generic clinical manifestations of paranasal sinusitis include *pain* which differs in its location according to the sinus involved *nasal* and *postnasal discharge* the latter producing an obstinate hacking cough increase in or return of the *constitutional symptoms* of the cold as manifested by malaise anorexia pyrexia chilliness and generalized aches and pains

Acute Ethmoid Sinusitis —The ethmoid cells are the most commonly infected paranasal sinuses There is some degree of involvement in each acute rhinitis which persists beyond a week The patient complains of *headache* referred to the bridge of the nose or the region of the temple behind the eyes There is usually some degree of *anosmia*

Intranasal examination reveals marked edema and swelling of the middle turbinate and in the anterior ethmoidal regions Pus in the anterior portion of the middle meatus is derived from the anterior ethmoidal or frontal sinus cells secretion from the posterior ethmoidal cells is visible above the middle turbinate *Children* may develop edema of the upper lids which often is the first indication of an *orbital cellulitis* (p 1615) secondary to ethmoid cell infection Roentgenograms at most disclose cloudiness of the ethmoid cells and indistinctness of the walls

Ethmoid sinusitis usually acts as a starting point for other paranasal involvements and these in turn tend to perpetuate the ethmoidal infection

Acute Maxillary Sinusitis —Maxillary sinusitis is usually secondary to acute ethmoiditis Much less frequently maxillary sinusitis results from the spread of infection from an *apical abscess* about the root of an upper molar or premolar tooth with or without local osteomyelitis (p 1706) Maxillary sinusitis of dental origin also occurs when the cavity of the sinus is entered during dental operative treatments such as extraction or root canal filling (p 1663)

The earliest indication of maxillary sinusitis is usually *pain in the cheek* which is often referred to the upper posterior teeth or supra orbital region Tenderness on pressure occasionally can be elicited over the anterior wall of the maxillary sinus

Intranasal examination shows purulent secretion in the middle meatus about the region of the natural orifice of the sinus Occasionally thick pus is adherent to the inferior turbinate which is edematous and congested especially at the posterior inferior tip Transillumination and roentgenography reveal clouding on the involved side and purulent fluid is obtained by irrigation through the natural orifice Puncture of the inferior meatus is necessitated if marked septal deviation or turbinal hypertrophy prevents introduction of the cannula into the natural orifice

Maxillary sinusitis of dental origin may be insidious or hyperacute In the former instance the symptoms are those of a unilateral maxillary sinu

sitis without a history of antecedent nasal infection In the more virulent types of maxillary sinusitis of dental origin the patient is febrile pain is severe and swelling and tenderness are noted in the regions of the cheeks and lids, the teeth are sore and foul pus drains from the middle meatus

Acute Frontal Sinusitis —Acute frontal sinusitis is much less common than acute ethmoiditis to which it is almost always secondary The diagnosis i suggested by the characteristic *headache* (p 1510) which occurs in the fore noon lasts several hours and disappears toward late afternoon *Tenderness* is elicited on pressure over the anterior wall and floor of the frontal sinus Percussion tenderness may outline the entire content of the involved sinus

Intranasal examination discloses intense congestion of the anterior portion of the middle meatus in the region of the uncinate process Thick pus



Fig 488—Lateral view of the nasal sinuses *F* Frontal sinus *E* ethmoid sinus S sphenoid sinus *M* maxillary sinus All the sinuses are normal from the roentgenologic aspect The sphenoid sinus is fully pneumatized that is it fills the sphenoid base even extending into the posterior clinoid process *

is seen after mucosal shrinkage unless congestion is excessive On transillumination and roentgenographic examination clouding of the involved side is revealed Edema of the upper and lower lids suggests an associated *periostitis* or early *osteomyelitis* of the frontal bone

Acute Sphenoid Sinusitis —Acute sphenoiditis is usually associated with an acute posterior ethmoiditis *Headache* (p 1510) is most often referred to the occiput behind the eye or in the temperoparietal region Pain may be exaggerated by motion of the head Severe infections may be accompanied by evidences of *meningeal irritation* (p 1432), such as *photophobia* and *spasticity of the neck* Examination of the nose reveals congestion of

* Ballenger in Pullen Medical Diagnosis

the posterior ethmoid region On posterior rhinoscopy the anterior wall of the sphenoid sinus may appear red and purulent exudate is seen in the spheno ethmoidal recess and in the fossa of Rosenmuller

Treatment

During the acute phases of a paranasal sinusitis *vasoconstrictor sprays* are employed followed by *steam inhalations* under a tent These measures shrink the nasal mucous membrane and permit the drainage of retained pus from the infected cells Neosynephrin (0 25 to 1 per cent) or privine (0 05 to 0 1 per cent) are satisfactory vasoconstrictors since 3 per cent ephedrine and 1 1000 epinephrine produce secondary congestion The vaso constrictor spray is used every two hours Within fifteen minutes the steam inhalation is initiated and continued for fifteen to twenty minutes after which it is necessary to sponge and dry the patient

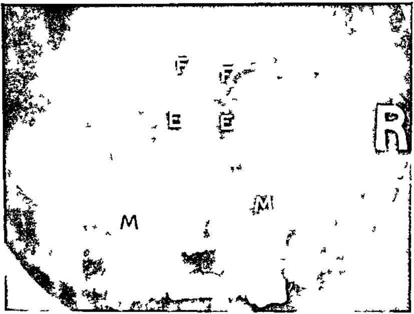


Fig 489 —Postero anterior view of the nasal sinuses showing cloudy left antrum (*M*) cloudy frontals (*F*) and cloudy ethmoid (*E*) The heavy shadows just below the orbits and covering the upper portion of the maxillary sinuses are produced by the base of the skull and the malar bones

With marked congestion that fails to respond to the simpler vasocon strictors it becomes advisable to apply locally equal parts of 2 to 5 per cent *cocaine hydrochloride* and 1 1000 *epinephrine* To prevent untoward manifestations of cocainization (p 3915) the patient is given liberal dos ages of phenobarbital with codeine sulfate and acetylsalicylic acid

℞ Phenobarbital	0 5
Codeine Sulfate	0 5
Acetylsalicylic Acid	4 5

Divide and make 15 capsules
S On every hour for 4 doses

Ballenger in Pullen Medical Diagnosis

Specific Therapy—All but the less severe examples of *sinusitis* require the systemic uses of sulfonamides (p 88) penicillin (p 106) or streptomycin (p 103) *Absolute indications* exist in the presence of more than moderate constitutional manifestations when there are evidences of orbital cellulitis periostitis or osteomyelitis in maxillary infections of dental origin and in infection that persists beyond thirty six to forty eight hours The parenteral injections should be supplemented by nebulization (p 2118) and aerosolization (p 2041)

Non operative Drainage—Specialist consultation is required when symptoms persist or seem to get beyond control *Antral lavage* through the natural orifice or by puncture of the inferior meatus relieves the local inflammatory process and also influences favorably a persistent ethmoiditis If pus is obtained the lavage is repeated after forty eight to seventy two hours and at intervals until the returns are clear

Retention in the frontals often responds to the application in the anterior ethmoidal region of a tampon of cotton soaked in 20 per cent cocaine and a few drops of 1 per cent neosynephrin With increase in symptoms and obviously inadequate drainage the expert may attempt irrigation of the *frontal sinus* through the nasofrontal passage Irrigations of the *sphenoid* are technically possible but the ethmoidal labyrinth cannot be lavaged

Surgical Therapy—With further advance in the infective process emergency surgery may be required in conjunction with preoperative and post operative specific therapy using sulfonamides (p 88) or penicillin (p 106) In *maxillary sinusitis* of dental origin infected teeth must be removed and dead bone and granulation tissue curetted from the infected socket With persistent infection a window is made into the infected antrum and an attempt made to close the fistula into the mouth Radical procedures for drainage of the *frontals* require external incision but *sphenoethmoidectomy* is performed intranasally

Complications

The more serious complications of paranasal sinusitis include *rhinogenic meningitis brain abscess thrombosis of the cavernous sinus orbital cellulitis orbital abscess cryptogenic sepsis osteomyelitis of skull and epidural abscess*

Rhinogenic Meningitis—Invasion of the meninges as a result of infection in the paranasal sinuses is most often the result of lesions in the *sphenoid* and *ethmoid cells* The pathways of spread are by direct extension through an *osteomyelitis* or *osteitis* by way of the *perineural lymph sheaths* or *perivascular lymph channels* through *perforating vessels* into the cavernous sinus by direct invasion of the *meninges* through a congenital dehiscence or a persistent craniopharyngeal pouch

Clinical Manifestations—The cardinal symptom of meningeal involvement due to sphenoid sinus disease is severe *pain* in the occiput radiating to the temporal region and down the spine The occipital pain is often excruciating unyielding and most marked at night Accompanying manifestations are low grade *pyrexia chilling vomiting photophobia vertigo* and *stupor* Physical examination usually reveals a *spastic or rigid neck* and positive *Kernig* and *Brudzinski* signs

Intranasal Examination—Intranasal examination may suggest evidences of suppuration in the sphenoid sinus *Irrigation of the sphenoid sinus* by the specialist after thorough cleansing of the nasal cavity is the most dependable test for determining the presence or absence of sphenoid sinus infection *Roentgenograms* are of value when positive but normal films must not delay irrigation of the sphenoid The specialist may find it necessary to retract the middle turbinate in order to reach the ostium of the sinus but this must not deter the practitioner from having the irrigation performed Usually the infected sphenoid sinus is well pneumatized and often extends into the posterior portion of the basisphenoid

The presence of severe frontal pain transient edema of the supraorbital structures or an orbital cellulitis points to a possible focus in the *frontal sinus* Careful intranasal examination and posterior rhinoscopy by the specialist may reveal pus in the spheno ethmoid or olfactory sulcus

Lumbar Puncture—After the intranasal examination is completed a lumbar puncture is required for bacteriologic and cytologic studies The presence of a gram negative coccus points to a *meningococcal meningitis* (p 213) clear fluid is observed in *tuberculous meningitis* (p 262) *acute encephalitis* (p 441) and *poliomyelitis* (p 457) frankly bloody or xanthochromatic spinal fluid suggests a *subarachnoid hemorrhage* (p 1454) and purulent fluid containing polymorphonuclears and gram positive cocci indicates the possible presence of a rhinogenic type of meningitis

Treatment—The optimal treatment for rhinogenic meningitis requires the combination of sulfonamide (p 88) and/or penicillin (p 106) and *surgical drainage* Neither one of these efforts is followed by satisfactory results without the accomplishment of the other The systemic uses of the anti infective agents should be supplemented by intrathecal instillation of penicillin using 500 to 1000 units per cc In a spheno ethmoiditis an *intranasal spheno ethmoidectomy* is required With frontal sinus involvement an *external exploration* is performed involved bone is completely removed and powdered sulfonamide is locally deposited

The fulminating clinical course of a rhinogenic bacterial meningitis may be masked by chemotherapy Under these circumstances a violent exacerbation follows withdrawal of the drug attesting to the necessity of combining surgical drainage with chemotherapy

Rhinogenic Brain Abscess—Brain abscess of sinus origin is less common than otogenic brain abscess (p 2148) *Frontal sinusitis is the* commonest cause of rhinogenic brain abscess but *ethmoid* and *sphenoid* infections also may produce similar lesions The rhinogenic brain abscess is usually situated in the *frontal lobe*

Pathology—Intracerebral infections occur from rupture through the adjacent sinus wall or by spread of infection through the communicating vessels between the sinus mucosa and the meninges The brain cortex is more resistant to the spread of infection and usually shows a fibrous inflammatory stalk which leads into the medulla where the main abscess cavity is situated The degree of encapsulation depends upon the virulence of the primary lesion *Osteomyelitis* of the bony wall of the involved sinus localized meningitis or *epidural abscess* may accompany the brain abscess

Clinical Manifestations—The early symptoms of rhinogenic brain abscess are very difficult to recognize They are usually overshadowed by and similar to the symptoms of the sinusitis which is the primary cause Per

sistent headache and *vomiting* which do not respond to drainage of the involved sinus suggest that a brain abscess may be present The development of *choked disk* (p 1577) is certain evidence of intracranial involvement

Treatment—Anti infective therapy is given until the rhinogenic brain abscess is well localized and encapsulated The use of *sulfonamides* (p 88) and/or *penicillin* (p 106) may prevent the spread of the abscess and diminish the danger of a secondary meningitis however chemotherapy must not delay local treatment of the primary focus in the involved sinus Eradication of the primary focus may produce definite improvement in the neurological condition even though the abscess persists At a later time the brain abscess is drained through a clean area in the skull

Rhinogenic Cavernous Sinus Thrombosis—Cavernous sinus thrombosis occurs as a complication of paranasal sinus infection through communicating veins by spread through the pterygoid plexus and from infections of the pharynx and neck Most often the *staphylococcus aureus* is recovered but *hemolytic streptococcal invasions* also occur

Clinical Manifestations—The clinical manifestations of a rhinogenic cavernous sinus thrombosis are similar to those that occur from venous *involvement arising from any other cause* (p 1447) *During the course of* a sinus infection the appearance of *exophthalmos edema of the eyelids* and *periorbital regions fixation* and *proptosis* of one eye and then the other *edema of the retina* and dilatation of retinal veins with *septic fever* and *bacteriemia* leave little doubt as to the diagnosis In later phases meningeal involvement is also encountered

Treatment—*Combined chemotherapy with sulfonamide* (p 88) and *penicillin* (p 106) and *surgical drainage* are required for preservation of life in the presence of a cavernous sinus thrombosis The specialist is summoned for performance of a *sphenoid ethmoidectomy* Following operation if there is no danger of hemorrhage *heparinization* (p 1050) may be attempted in order to expose the organisms more fully to the chemotherapeutic agent

In patients who cannot be subjected to operation because of the excessive surgical risk the combination of *chemotherapy* and *heparinization* is attempted There is the possibility that antibiotic agents such as *penicillin* (p 106) may prove even more effective in combination with the anticoagulant

Rhinogenic Orbital Cellulitis and Orbital Abscess—Orbital cellulitis and orbital abscess occur as complications of *spheno ethmoiditis* and *frontal sinusitis* especially in the young Dehiscences in the thin *lamina papyracea* predispose to extension of infection from the posterior and anterior ethmoid cells into the orbit The first spread is into the cellular tissues producing *chemosis local pain* and *fever* Later an orbital abscess develops with advancing *proptosis* and evidences of *local osteomyelitis*

In the adult *orbital cellulitis is more apt to occur from a rupture* through the floor of the *frontal sinus* Perforations of the lamina papyracea of the ethmoids are less frequent than in children Occasionally an orbital cellulitis results from extension through the superior wall of the antrum

Treatment—The treatment of orbital cellulitis orbital osteomyelitis

and orbital abscess requires the combination of *surgery* and *chemotherapy* Both rhinologist and ophthalmologist are consulted to consider the optimal site for surgical drainage If the frontal sinuses appear absent on roentgenograms or the surgeons feel assured that they are not involved the orbital abscess may be drained intranasally to avoid external operation

Rhinogenic Sepsis —Acute paranasal sinusitis may be responsible for an apparently cryptogenic sepsis (p 26) This baffling circumstance is more apt to be observed in infants who cannot register their complaints but it also occurs in adults who develop neither local pain nor tenderness at the site of the infection

The possibility of paranasal sinusitis is always worthy of consideration in the elucidation of a cryptogenic sepsis (p 26) If the suspicion of the practitioner is aroused local examinations and roentgenograms are supplemented by *diagnostic lavages* of antrums and sphenoids Treatment combines indicated surgery and intensive administration of sulfonamide and/or penicillin (p 106)

CHRONIC PARANASAL SINUSITIS

Chronic paranasal sinusitis follows neglected or inadequately treated episodes of *acute sinusitis* (p 2124) and results from the continued operation of the same predisposing factors

Chronic infection is particularly prevalent in individuals with anatomical deformities which hinder drainage or expose a portion of the nasal cavity to excessive drying through the deflection of air currents More specifically the provocative lesions include *septal deviations deformities of the nasal vestibule a dependent nasal tip collapsed alar cartilages hypertrophy* of the *turbinal bone polyps vasomotor or allergic rhinitis atrophic rhinitis neoplasms* specific *granulomatous infections adenoid hypertrophy infected tonsils* a *Thornwaldt abscess* or the extension of a *periapical dental abscess* into the antrum

Bacteriology —The common bacterial invaders in chronic sinusitis are the *Staphylococci aureus and albus hemolytic and nonhemolytic streptococci pneumococci M catarrhalis* and *H influenzae* The offending organism may cause direct inflammatory changes or it may set up an allergic vasomotor rhinitis (p 2098)

Pathology.—Hypertrophic infiltrative and atrophic varieties of chronic sinusitis are encountered The cardinal soft tissue change consists in a degeneration of the *specialized epithelium loss* of ciliary action and replacement by squamous epithelium The submucosa becomes thickened edematous and infiltrated with leukocytes lymphocytes plasma cells and an *occasional* eosinophil There is increase in fibrous tissue with resultant scar formation and atrophy of the mucous secreting glands

In the *hypertrophic type* the mucosal reaction progresses to polyposis with cystic degeneration In the *infiltrative type* the mucous walls thicken the submucosa swells purulent *exudate is formed* but there is no polyp formation In the *atrophic form* there are evidences of *an obliterative* endarteritis of the submucosal vessels with atrophy of the turbinal bones of the *nasal* mucosa *Periostitis* follows from extension of the infection to the bone of the sinuses Eventually a low grade or spreading osteitis complicates the nasal sinus infection particularly in the frontals and sphenoids

Clinical Manifestations —Chronic paranasal sinusitis may be *asymptomatic* More often however it produces *local focal allergic* and/or *systemic consequences*

Local Symptoms—The local symptoms include nasal obstruction, nasal discharge headache cough expectoration and recurrent colds

DIFFERENTIAL DIAGNOSIS OF

Pain in the Face

Pain in the face must be distinguished from headache (which is discussed el ewhere at length—p 1510) The many *etiologic factors in the production of facial pain* require that extensive investigation be performed often involving cooperation with dentist rhinologist ophthalmologist *otologist* and neurologist

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Hyperalgesia (Cutaneous Pain)	Herpes zoster erysipelas and furunculosis *Note local eruption*
Odontalgia (Dental Pain)	Gingivitis periodontitis alveolar absce s and caries of teeth Osteomyelitis of jaw or tooth sockets Examine mouth with good illumina tion Get x rays of jaw and consult dentist.
Otalgia	Referred pain from furunculosis of external auditory canal otitis media acute myringitis or mastoiditis *Otoscopy* Get x rays of both mastoids and consult otologist
Rhinalgia	Abscess of septum or furunculosis of nares *Maxillary sinusitis Perform* anterior rhinos copy (p 3592) Transilluminate (p 3595) and x ray sinuses Consult specialist for diagnostic lavage
Tic Douloureux	Trigeminal or trifacial neuralgia *Acute spasms involving maxillary mandibular or* ophthalmic divisions In maxillary neuralgia *point of maximum tenderness over infra* orbital foramen, pain extends to teeth With mandibular neuralgia point of maximum tenderness over mental foramen just above and lateral to point of chin, pain extends to lower jaw chin ear gums and teeth In ophthalmic neuralgia point of tenderness over supra orbital notch *pain travels along* forehead roof of nose and eyes Refer to *neurosurgeon for diagnostic and therapeutic* injections
Geniculate Neuralgia	Usually with herpes zoster and pain referred to external auditory canal
Sphenopalatine Neuralgia	Sluder s syndrome due to disturbance of *Meckel s ganglion Pain at root of nose pro* gressing to gums and teeth of upper and lower *jaws May extend laterally to temples behind* ear over mastoid process and down occiput, *neck* shoulders hands and fingers Relief from cocainization of ganglion (p 1483)
Vidian Neuralgia	Symptoms similar to sphenopalatine neuralgia but no relief from cocainization of ganglion (p 1483)

The *commonest presenting symptom of chronic paranasal sinusitis is* persistent *nasal obstruction* (p 2732) which may be unilateral bilateral or

alternating A frequent observation is occlusion of the dependent nostril when the patient reclines The nasal obstruction may be due to simple edema congestion of the turbinal mucosa enlargement or polypoid degeneration of the posterior tip of the inferior turbinate septal deviation or the presence of purulent secretion crusts and scabs

Nasal and post nasal discharges invariably accompany the chronic sinus infection The material may be slight in amount and mucoid or it may be abundant dried or crusted The discharge usually is most annoying on arising when it becomes necessary to blow the nose hawk and spit in order to clear the passages Often the associated gagging leads to nausea and vomiting

Recurrent or constant *headache* is frequently observed in chronic sinusitis The pain may be unilateral or bilateral it is usually worst in the morning and lifts as the day progresses The location depends in part upon the situation of the involved sinus *antral infection* produces pain over the cheek teeth or frontal regions *frontal sinus* involvement is suggested by pain in the forehead and supra orbital region *ethmoiditis* may be manifest by pain at the roof of the nose behind the eyes over the parietal or posterior occipital regions *Sphenoidal headaches* are usually occipital and may radiate to the interscapular region along the shoulders into the arms and along the course of the *sphenopalatine ganglion* (sphenopalatine neuralgia) to the areas behind the ear over the occiput in the face and down the side of the neck

Chronic cough is an invariable accompaniment of paranasal sinus suppuration The postnasal discharge irritates the pharynx and larynx and efforts at expulsion add an insult to the indignity of the postnasal drip The cough is usually worst early in the morning and at night after the patient has attempted to settle down for sleep It may occur in paroxysms suggesting a *pertussis* (p 278) *Associated hypertrophy of the lingual tonsils* (p 2152) or a *congestive laryngitis* (p 2161) adds to the irritative phenomena

The cough of paranasal sinusitis usually is associated with *expectoration* of purulent material *Blood-spitting* consequent to trauma and *emesis* resulting from gagging create a strong suspicion of a *pulmonary tuberculosis*

Recurrent Colds—The chronic paranasal sinus infection is punctuated by frequent acute exacerbations These so-called recurrent colds differ from the common upper respiratory infection in that they are often caused by demonstrable *bacteria* the initial *congestive phase* and *rhinorrhea* are minimal and *constitutional symptoms* are apt to be less marked particularly in the prodromal period

Focal Symptoms—At times the chronic paranasal sinusitis becomes manifest through disturbances in distant areas The common focal manifestations include *arthralgias* (p 2802) *myalgias* (p 2894) *neuralgias* (p 1482) *arthropathies* (p 2855) *uveitis* (p 1632) *keratitis* (p 1626) *scleritis* (p 1631) *nephropathies* (p 2362) and *bronchiectasis* (p 2059)

Allergy—The relationship of allergy and chronic purulent sinusitis is complex and difficult of elucidation A straightforward pollen allergy such as *hay fever* (p 2097) may be complicated by *secondary bacterial infection* leading to the production of a *chronic paranasal sinusitis* The latter

adds to the gravity and the persistence of the former and may still be present when the pollens have disappeared from the atmosphere The diagnosis of pollen allergy is then doubted and the result of pollen desensitization is erroneously regarded as disappointing

On the reverse side of the coin chronic suppuration in the paranasal sinuses may produce sensitization of the local tissues to the invading bacteria In such an example the vasomotor rhinitis is non seasonal (p 2098) eosinophils are present in the secretion and allergic edema of the membranes of the nose adds to the *difficulties of drainage* predisposes to acute exacerbation and secondary infection and altogether, lends chaos to an already difficult situation

Systemic Symptoms—With or without obvious localizing manifestations chronic paranasal sinusitis may result in generalized systemic phenomena such as *malaise* low grade *pyrexia* episodes of *chilliness* and *sweating loss of weight* and *appetite* and weakness and general debility The clinical picture together with the constant cough strongly suggests the presence of a *pulmonary tuberculosis* (p 2199) and requires extensive investigation including chest roentgenograms and examinations of concentrated sputum for the presence of the tubercle bacilli (p 51) In childhood the syndrome suggests the manifestations of a *rheumatic fever* (p 186) particularly if associated with focal myalgia, arthralgia and a rapid sedimentation rate of the erythrocytes

Physical Findings—In chronic paranasal sinusitis the objective findings may be deceptively few The practitioner notes hypertrophy or atrophy of the nasal mucosa polyp formation hypertrophy and polypoid degeneration of the turbinates collections of secretion and pus within the cavities of the nose and postnasally and variable tenderness over the involved sinus Opacities revealed by transillumination (p 3595) or roentgenogram (p 2127) may be deceptive since failure to transmit the light or the ray does not necessarily indicate the presence of active infection and translucency may accompany significant involvements

Diagnosis—The definitive diagnosis of chronic paranasal sinusitis is specialist province The practitioner refers the patient to the *rhinologist* who conducts his survey after attempting to shrink the mucous membrane with a spray of cocaine and epinephrine Particular significance is attached to exudate in the middle meatus the sphenoidal recess or the nasofrontal regions *The reappearance of pus after suction is emphasized Diagnostic lavage* of the antrums and sphenoids may be necessitated The sterile cannula is introduced without contamination and the material obtained is immediately planted *on a blood plate and streaked on slides One slide* is stained by the *Wright technic* (p 52) for determination of the percentage of eosinophils the other is treated by the *Gram method* (p 52) for a description of the morphology of the prevailing organism When the *cultures* have been grown the organism or organisms are compared with those seen on the direct smear *Bacteria free filtrates* are used for skin testing in *patients* who have eosinophilia *vaccines* are prepared for immunization or desensitization

It is surprising to note with what frequency the diagnosis of chronic sinusitis is overlooked In focal infection (p 42) and cryptogenic sepsis (p 26) the discovery of chronic nasal sinusitis requires a high index of

suspicion and a willingness to conduct a painstaking survey We are convinced as elsewhere stated that many of the allegedly tuberculous ophthalmologic lesions (such as uveitis and choroiditis) are much more likely consequences of focal infection in the paranasal sinuses Retrobulbar neuritis may be secondary to sinusitis and may be relieved by intranasal therapy

In the absence of local manifestations the diagnosis is established by objective investigation In these efforts the practitioner is often opposed by the wishes of the patient who is unwilling to undergo painful examinations of areas which have apparently caused no distress

Differential Diagnosis—The differential diagnosis of chronic paranasal sinusitis depends upon the presenting manifestations The patient whose dominant complaint is *headache* (p 1510) requires special investigations which are elsewhere detailed More serious is the problem that arises when the symptom complex suggests systemic bacterial invasion particularly *tuberculosis* (p 252) Both conditions exhibit cough sputum pyrexia anorexia loss of weight chilliness and episodes of sweating The practitioner does not rest content until he has established beyond a question of doubt the presence of pus originating in the paranasal sinuses or of a tubercle bacillus in the concentrated sputum

The astute practitioner does not discontinue his survey upon demonstration of definitive evidence of the presence of one or the other infection He recalls that each of the conditions is sufficiently common so that their coexistence often may be anticipated

Complications—Chronic paranasal sinusitis in an acute exacerbation is subject to the same complications as an acute paranasal sinusitis (p 2124) These include *rhinogenic meningitis cavernous sinus thrombosis orbital cellulitis and abscess* and *brain abscess* Additionally the chronically inflamed sinus may be the site of a mucocele a pyocele a pneumatocele or cyst formation

Mucocele—A mucocele arises from retention of mucoid secretion in a paranasal sinus The resulting pressure may cause thinning and perforation of a wall Mucoceles are most often seen in the *frontal sinus* where their presence is suspected by the persistence of slight headache relieved by a sudden dicharge of mucoid secretion into the nose In advanced instances a bulge is noted at the upper inner angle of the orbit this becomes progressively larger and may be hard crepitant or fluctuant *Roentgenograms* may disclose bony defects due to erosion of the sinus walls by the pressure of the mucocele

A mucocele of the *ethmoid labyrinth* is difficult to differentiate from a *cyst of the lacrimal sac* (p 1566) The latter usually is accompanied by the discharge of purulent secretion from the nasolacrimal ducts

The presence of a mucocele requires adequate opening into the sinus cavity to permit free drainage into the nose In frontal sinus mucocele an external approach is usually necessitated

Pyocele—The pyocele is similar to the mucocele except that there is pus within the cavity Actually the condition represents an infection of a mucocele and it is treated similarly

Pneumatocele—In the pneumatocele air is collected under pressure in the tissues A defect or break in the bony wall of the sinus permits air to

escape from the nasal cavity into the surrounding tissues particularly when the patient coughs or forcibly blows the nose The disturbance often is encountered with fractures of the nose sustained by prize fighters or wrestlers

Cysts of the Maxillary Sinuses—Maxillary sinus cysts may be due to retention in a mucosal gland or they may be dentigerous The presence of the cyst is suggested when clear straw colored fluid is lavaged from the maxillary sinus Microscopic examination reveals the presence of cholesterol crystals and roentgenograms with and without lipiodol injection are needed to confirm the diagnosis The demonstration of the cyst calls for operative intervention

Treatment—The treatment of chronic sinusitis is an individual problem that is currently becoming more encouraging Frequent *lavages* are of occasional value in clearing a maxillary sinus involvement but they are less efficacious in sphenoidal and frontal sinus disease and cannot be done in ethmoidal involvement Occasionally ethmoidal infections are relieved by antral lavage The *removal of obstructions and swellings* in the middle meatuses facilitates drainage from the ethmoid labyrinth *Nasal douches* of warm saline decrease the amount of postnasal discharge and relieve obstruction due to inspissated secretion *Steam inhalations* preceded by the use of a *vasoconstrictor* favor drainage but accomplish little else

Intensive antibiotic therapy merits intensive and protracted trial For oral use alone sulfadiazine (p 88) occasionally is efficacious but greater success may be expected from penicillin (p 106) or streptomycin (p 103) given parenterally by nebulization (p 2118) and by aerosolization (p 2041) Supplementation with pyribenzamine (p 565) for anti histamine effects is advised as a therapeutic test for an allergic element and to prevent sensitization to the antibiotics

In our experience nothing significant is consistently obtained from *physiotherapy* by *ultraviolet infra red or diathermy Climatotherapy* and *spa therapy* (p 3764) permit the patient to escape to new surroundings with renewed hope

Surgery—The operative treatment of chronic sinus disease may yield great benefit with minimal risk The simple procedures which have little hazard and possess considerable promise of amelioration include resection of a deviated septum or occluding middle turbinates drainage of Thornwaldt abscess (p 2140) enucleation of diseased faucial or lingual tonsils (p 2153) removal of hypertrophied and infected adenoids (p 2140) snaring of polyps and hypertrophied turbinal tips bilateral intranasal antrotomy and removal of periapical abscesses in teeth which impinge upon the maxillary antrum These should be preceded and followed by antibiotic therapy

The more radical operative procedures whose execution should be delayed until the simpler measures have been tried include radical antrotomy external drainage of the frontal sinuses and intranasal spheno ethmoidectomy

RHINOSCLEROMA OF PARANASAL SINUSES

See p 2109

ACUTE NASOPHARYNGITIS

Acute infections of the mucous membrane of the nasopharynx are most often non bacterial *Streptococcal invasions* may occur in asso

ciation with *adenoiditis* (p 2139) and *faucial or lingual tonsillitis* (p 2153) The infection is highly contagious It is transmitted from person to person by air borne droplets or direct contact or it may be milk borne in epidemic forms (p 185) Its development is often precipitated by a surgical procedure involving the nose or the paranasal sinuses

Clinical Manifestations —In an acute nasopharyngitis there is congestion of the mucous membranes of the nasopharynx larynx tonsils and tonsillar pillars Constitutional symptoms are variable and may be mild or of considerable severity Posterior cervical adenitis may produce irritation and spasm of the trapezius and stiffness of the neck suggesting meningeal irritation Locally the patient complains of dryness soreness and a burning sensation in the pharyngeal region aggravated by swallowing There may be considerable thick tenacious mucoid secretion in the nasopharynx and pharynx

Membranous Pharyngitis —Membranous pharyngitis is most often *diphtheritic* (p 302) though it may be *fusospirochetal pneumococcal* (p 199) or *streptococcal* (p 185) In a diphtheria the onset and constitutional manifestations are often deceptively slight Low grade *pyrexia* moderate *dysphagia* and *cervical adenitis* are noted and dirty gray *membrane* forms in the pharynx and spreads from the tonsils to the soft palate and uvula Characteristically the membrane is adherent and when it is stripped off a bleeding surface is revealed underneath (Fig 44 p 303)

The *diagnosis* of membranous pharyngitis is a laboratory procedure Smears and cultures are required The dictates of wisdom favor the administration of *diphtheria antitoxin* (p 310) unless the bacteriological survey clearly exonerates that organism

Ulceromembranous Pharyngitis —Ulceromembranous pharyngitis is often caused by *fusospirochetes* (p 355) The pharyngeal infection may be secondary to a *gingivitis* (p 1699) It is transmitted from person to person by direct contact or by the use of common eating utensils Ordinarily the involvement is limited to one side of the pharynx or a single tonsil There are few systemic manifestations and there may be inappreciable local pain The diagnosis is established by the examination of smears and failure to find diphtheria organisms by cultural methods

Since an ulceromembranous pharyngitis is a frequent herald manifestation of a *blood dyscrasia* particularly *leukemia* (p 1100) a hemogram is required in each instance

Herpetic Pharyngitis —Vesicular pharyngitis occurs as a manifestation of *herpes simplex* (p 433) The mucosa is congested and small blebs are visible The nature of the disturbance is suspected from the inordinate degree of *burning* and *pain* which precede and accompany the appearance of the local vesicles

Treatment —The *local therapy* of nasopharyngitis is limited to measures of palliation Gargles are useless but cold compresses externally applied often give considerable relief Throat irrigations (p 2027) with hot strong tea or saline solution are often grateful Lozenges impregnated with local anesthetic preparations may afford some relief of dysphagia Attempts at local chemotherapy using paintings of silver salts iodine mercurochrome or sulfonamide accomplish nothing but local trauma

The *systemic treatment* of acute nasopharyngitis is dependent upon

the etiology of the disturbance Diphtheritic infections require the administration of the specific *antitoxin* (p 310) streptococcal pneumococcal and fusospirochetal invasions may respond to the administration of *sulfonamide* (p 88) and/or *penicillin* (p 106) Processes of more than moderate severity merit probatory antibiotic therapy using penicillin parenterally and by nebulization (p 2118) and aerosolization (p 2041)

CHRONIC NASOPHARYNGITIS

Chronic nasopharyngitis in most instances accompanies more fundamental primary lesions of the respiratory passages elsewhere Atrophic and hypertrophic reactions are observed in association with *atrophic rhinitis* (p 2122) *hypertrophic rhinitis* (p 2120), *allergic rhinitis* (p 2096) *chronic paranasal sinusitis* (p 2131) *marked septal deviation* with resultant mouth breathing *adenoid hyperplasia and infection Thornwaldt abscess* and *lingual tonsillitis*

Atrophic Nasopharyngitis—In the atrophic types of nasopharyngitis the membrane is glazed there is persistent crusting and the breath has a foul odor The association of these annoyances leads to anorexia gagging chronic cough nausea and vomiting

Hypertrophic Nasopharyngitis—In hypertrophic nasopharyngitis the throat feels raw there is considerable thick tenacious material plastered on the back of the pharynx the lateral pharyngeal folds become prominent and thickened and expectoration is difficult and is associated with gagging nausea and vomiting The mucous membrane appears beefy bleeding is easily induced and is followed by the appearance of blood crusts The combination of chronic cough and blood stained sputum arouses the suspicion of a *tuberculosis* (p 252)

Treatment—The treatment of chronic nasopharyngitis is directed at the correction of the more fundamental difficulty Hypertrophied or infected adenoids lingual and faucial tonsils are removed the deviated septum is corrected by plastic surgery and an attempt is made to secure adequate drainage in chronic paranasal sinusitis (p 2131) Antibiotic treatment with penicillin given parenterally by nebulization and aerosolization (p 2041) merits trial with supplementary use of pyribenzamine for its anti histamine effect (p 565)

MYCOSES OF THE NASOPHARYNX (THRUSH)

The mycoses of the nasopharynx produce subacute inflammation with the appearance of *patches of exudate* One of the more common is *thrush* caused by the *Oidium albicans* and seen in marasmic and poorly nourished infants and debilitated adults

Thrush—Creamy white patches are observed on the mucous membrane of the cheeks tongue lips and pharynx The albicans organism is demonstrated in fresh smears and on cultures planted on special media (p 53) Less often chronic ulceration of the pharyngeal mucous membrane is observed in *sporotrichosis* (p 495) *blastomycosis* (p 493) and *actinomycosis* (p 489) In each of these instances the diagnosis is established by bacteriological methods

Treatment—With mycotic infections *local applications* of 2 per cent gentian violet or 2 per cent salicylic acid in alcohol have some merit An

occasional satisfactory result has been obtained through the systemic use of sulfathiazole (p 88) or penicillin (p 106) The latter has displaced former methods of therapy with iodides and roentgen irradiation In obstinate instances all methods may be combined

ACUTE ADENOIDITIS

Acute follicular adenoiditis may occur alone but more often it is associated with infections in the *faucial or lingual tonsils* (p 2153) The disturbance usually is observed in children when it is cryptogenic due to the difficulty of visualizing the inflamed tissues

Clinical Manifestations —In acute adenoiditis the local lesion consists of edema congestion and the formation of *follicular spots* made up of desquamated epithelium fibrin and pus The coalescence of the follicles may form a fibrinous *cast* or a *diphtheritic membrane* (p 2137) *Nasal obstruction* is almost complete since both posterior choanae become tightly occluded *Cervical adenitis* of marked degree accompanies the infection *Constitutional symptoms* are usually severe with an initial chill a rapid rise in temperature to 102° to 106 F general malaise and anorexia

Enlargement of the cervical glands and their compression by the neck muscles often cause *nuchal rigidity* sufficient to warrant the performance of a *lumbar puncture* (p 3781) Reflex *otalgia* suggests the presence of an *otitis media* (p 2144) and calls for repeated examinations of the ear drum

Diagnosis —The diagnosis of acute adenoiditis often presents considerable difficulty The most easily observed manifestation aside from the swollen glands consists of the presence of a *postnasal purulent secretion* observed during the course of the examination of the pharynx Posterior rhinoscopy in infants and young children is technically too difficult for other than the expert

Acute adenoiditis in childhood is easily confused with a *generalized sepsis* a *diphtheritic infection* an *acute meningitis* or an inflammation of the *middle ear* If laboratory procedures are available a *blood culture* is taken and *smears* are made for direct examination and culture of the follicular exudate In instances of reasonable doubt a *lumbar puncture* is justified to determine the character of the cerebrospinal fluid

Course —The course of an acute adenoiditis is variable In many cases the hyperacute symptoms abate as rapidly as they have made their appearance and undoubtedly these account for many of the fevers of unknown origin in childhood In other instances the inflammation spreads to the *faucial* (p 2158) and *lingual tonsils* (p 2152) with their added complications Extension into the *eustachian tubes* with middle ear involvement produces many attacks of *otitis media* (p 2144) and its sequels including much of the *deafness* of later life

Treatment —While many attacks of acute adenoiditis subside without significant difficulty the course is so variable and the consequences so manifold that it is wise to institute immediate and vigorous therapy After cultures have been taken systemic chemotherapy with the *sulfonamides* (p 88) and/or *penicillin* (p 106) is begun *Diphtheria antitoxin* (p 310) is given additionally if there is clinical or laboratory evidence that points to a Klebs Loeffler infection

Local therapy is conducted by the topical use of vasoconstrictors and

steam inhalations with nebulization (p 2118) and aerosolization (p 2041) of solutions of penicillin (1 cc = 50 000 units)

Following recovery the child is subjected to *adenoidectomy* and *tonsillectomy*

ADENOID HYPERTROPHY

Adenoid hypertrophy and hyperplasia occur very frequently in early childhood The lymphoid tissue tends to regress as the youngster grows this factor in combination with the normal widening of the posterior nasopharynx may lead to spontaneous relief of postnasal occlusion unless infection persists

Clinical Manifestations—Adenoid hypertrophy produces symptoms as the result of mechanical obstruction of the posterior nares and the eustachian tubes The occlusive manifestations favor *repeated infections* of the nose paranasal sinuses pharynx tonsils and middle ear with their several complications Uncomplicated adenoid hypertrophy results in *mouth breathing nasal speech postnasal discharge cough vomiting* and alterations in the conformation of the face

Adenoid Facies—The adenoid facies consists of a shortened upper lip a perpetually open mouth protrusion of the upper teeth *malocclusions* (p 1665) a high arched palate and a general appearance of dulness and stupidity The breath is often fetid there is associated low grade infection of faucial and lingual tonsils and there may be a continued low grade *pyrexia*

Diagnosis and Treatment—The diagnosis of hypertrophy and the adenoid tissue is suggested on palpation with the finger introduced into the mouth and up to the vault of the nasopharynx This crude examination is confirmed by *posterior rhinoscopy* (p 2021) which usually requires the services of the expert

Adenoid hyperplasia calls for removal by *curettage* under general anesthesia The operation is ordinarily accompanied by *faucial tonsillectomy* Absolute indications include nasal occlusion frequent episodes of acute infection disturbances of hearing a constant postnasal drip or continued pyrexia that is otherwise unexplained

THORNWALDT S ABSCESS

Thornwaldt s abscess is a chronic low grade suppuration in the nasopharynx It arises within the mucosal lining of a persistent *nasopharyngeal bursa* or within the remnants of an infected mass of *adenoid tissue* It is situated in the median line and appears as a cystic swelling which bulges into the nasopharynx Most often it is associated with a *cheesy postnasal discharge* having an *unpleasant odor* noted by both patient and examiner

Clinical Manifestations—The clinical manifestations of the Thornwaldt abscess include the presence of the *discharge* a constant low grade *pharyngitis* repeated or chronic *paranasal infections cervical adenitis constitutional manifestations* a sustained low grade *pyrexia* and distant manifestations of *focal infection*

Mirror examination of the nasopharynx may show the crusted area and a honeycomb opening in the wall of the nasopharynx Direct examina

tion by use of the nasopharyngeal boot or the Yankauer nasopharyngo scope clearly discloses the mass and insertion of a probe often releases cheesy material or thick creamy pus

Treatment —Treatment consists of *surgical drainage* under local anes thesia and antibiotic therapy with penicillin (p 106)

DIFFERENTIAL DIAGNOSIS OF

Tinnitus

Ringing in the ear is a most annoying symptom It may have only nuisance value or else represent some such profound disturbance as brain tumor In consequence persistent or intractable tinnitus requires that the practitioner refer his patient to the consultant otologist or neurologist for more extensive investigation

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Mechanical Disturbances	Foreign bodies cerumen, osteoma stenosis stricture or furunculosis of the external audi tory canal Perform otoscopy Obstruction or stenosis of the eustachian tube Refer to otologist Imbalance of temporomandibular articulation due to loss of teeth or imperfect bite *Refer to dentist*
Infection	Acute myringitis and acute or chronic otitis media with visible changes of drum (p 2143) Acute or chronic labyrinthitis or petrositis with deafness and x ray changes (p 2147) Refer to otologist
Toxic and Metabolic Disturbances	Otosclerosis with deafness Refer to otologist Ménière s disease in acute attacks with nys tagmus Poisoning with quinine salicylate nicotine or alcohol Increased and decreased atmospheric pressure
Vascular Disturbances	Hypertension, aortic regurgitation hemor rhage into labyrinth or cerebral arterioscle rosis Record blood pressures and note fundus changes (p 3629)
Neurogenic Disturbances	Brain tumor of cerebellopontine angle with deafness and papilledema Syphilis of 8th nerve with positive Wassermann in cere brospinal fluid Basilar meningitis with changes in cerebrospinal fluid
Psychogenic Disturbances	Hysteria (p 1367)

INFECTION OF EUSTACHIAN TUBE

Extension of infection from the nasopharynx results in involvement of the eustachian tube through which the inflammatory process may be prop agated by continuity to the middle ear

Clinical Manifestations —Suspicion of eustachian involvement arises when in the course of the upper respiratory infection the patient com plains of fullness in the ear partial deafness tinnitus and shooting pains that extend from throat to ear *At this time* posterior rhinoscopy reveals

redness and swelling about the mouth of the tube and inspection of the ear drum discloses some infection Should the infection further progress to involve the middle ear the characteristic manifestations of an acute otitis (p 2144) develop progressively Without significant infection of the middle ear the eustachian tube may be closed by edema of the walls or obstruction by secretion under which circumstance the ear drum appears retracted the short process of the malleus seems more prominent and the light reflex is displaced If there is sufficient serous secretion in the middle

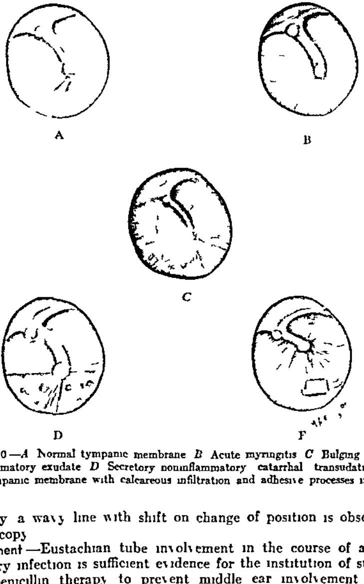


Fig 490 —*A* Normal tympanic membrane *B* Acute myringitis *C* Bulging drum head with inflammatory exudate *D* Secretory noninflammatory catarrhal transudation *E* Retracted tympanic membrane with calcareous infiltration and adhesive processes in the middle ear

ear cavity a wavy line with shift on change of position is observed by myringoscopy

Treatment—Eustachian tube involvement in the course of an upper respiratory infection is sufficient evidence for the institution of sulfonamide or penicillin therapy to prevent middle ear involvement At the same time the patient is given palliative treatment by the use of vasoconstrictors and steamings supplemented by penicillin nebulization (p 2118) and aerosolization (p 2041)

* Courtesy of Dr Maurice Alexander From Ersner in Jackson and Jackson, *Diseases of the Ear, Nose and Throat*

Persistence of tinnitus and impairment of hearing warrants specialist consultation for inflation and catheterization (p 2015) in order to prevent permanent damage to the auditory structures

DIFFERENTIAL DIAGNOSIS OF

Pain in the Ear (Earache, Otalgia)

Earache suggests a serious threat to the middle ear or a mastoid infection There are times however when the symptom represents a misleading reference of pain from structures of the oropharynx, particularly the teeth

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

External Ear	Trauma frostbite acute perichondritis or othematoma with obvious history or local findings Herpes zoster with characteristic vesicle (p 422) Erysipelas with pathognomonic eruption (p 167) Raynaud s disease with similar manifestations involving fingers and toes (p 1000)
External Auditory Canal	Foreign body furunculosis *otitis externa* or otomycosis Revealed by otoscopy
Systemic Infection	Mumps with parotitis Measles and scarlet fever with normal drum unless complicating otitis is superimposed. Look for characteristic cutaneous rash (p 172)
Oropharyngeal	Periodontitis and caries of teeth with local and x ray changes Adenoiditis tonsillitis acute accessory nasal sinusitis glossitis carcinoma of tongue peritonsillar or retropharyngeal abscess lymphoepithelioma or juvenile fibroma of nasopharynx carcinoma of tongue tonsil or larynx. Revealed by posterior pharyngoscopy and rhinoscopy (p 2021) Eustachian catarrh with relief following catheterization (p 2015)
Neurogenic	Trigeminal and glossopharyngeal neuralgias Tabes dorsalis with pupillary changes and positive findings in cerebrospinal fluid (p 1464) Tumor of cerebellopontine angle with tinnitus and deafness Consult neurosurgeon
Tympanic	Traumatic perforation of drum Acute myringitis with bulla of drum but no bulging (p 2143) Acute and chronic otitis media with bulging or perforation of drum (p 2151) Mastoiditis labyrinthitis or petrositis with characteristic radiographic changes (p 2147) Cholesteatomas Refer to otologist

OTITIS EXTERNA

The most frequent examples of otitis externa are described with the material on *furunculosis* (p 2111) and *otomycosis* (p 3305)

ACUTE MYRINGITIS

Acute inflammation of the ear drum may occur as the result of trauma or infection

Traumatic Myringitis—Traumatic myringitis follows awkward efforts to remove cerumen or foreign bodies and from the introduction into the canal of the ear of irritants such as phenol in attempts at local chemotherapy

The diagnosis is clearly apparent from the history The ear drum discloses evidences of *ecchymosis* and may be *perforated* Under the latter circumstance prophylactic chemotherapy with *sulfonamide* (p 88) or *penicillin* (p 106) is warranted

Infectious or Bullous Myringitis—Bullous myringitis is a frequent accompaniment of grippal influenzal and other types of upper respiratory infection (p 2105) Its recognition is highly important since it closely resembles an *otitis media* (p 2144) from which it must be differentiated in order to avoid serious errors in therapy

Clinical Manifestations—Acute myringitis is usually associated with *excruciating pain* that is almost invariably more severe than that experienced in otitis There is some *diminution in hearing* Local examination reveals changes in the canal as well as the drum The former is usually the site of an accompanying *vesicular eruption* the drum is partially or completely obscured by a *hemorrhagic bulla*

From the appearance of the drum alone it is impossible to distinguish between hemorrhagic bullous myringitis and acute otitis media In favor of inflammation of the drum membrane are the intensity of the pain the presence of vesicles within the canal and the hemorrhagic nature of the bulla

Treatment—Untreated bullous myringitis subsides as the result of spontaneous rupture of the bleb There are neither immediate nor late complications unless the physician in error performs a paracentesis and introduces infection into the otherwise uninvolved middle ear

ACUTE OTITIS MEDIA

Acute otitis media occurs as a complication of the *upper respiratory infection* (p 2105) The infected material travels by way of the eustachian tube into the tympanic cavity where it sets up an inflammatory process which may have many and serious complications

The development of an acute otitis media is predisposed to by the mechanical factor of *nasal obstruction* and by sudden increase in local pressure relationships In childhood the most frequent occlusive mechanism *is the presence of hypertrophied or enlarged adenoid tissue (p 2139)* the pressure disturbances involve the forcing of nasopharyngeal secretions into the aural passages as the result of overzealous blowing of the nose and injudicious local therapy during the acute phases of the respiratory inflammation

Bacteriology—The bacterial invader in acute otitis media is rarely the primary organism that has caused the respiratory infection In most instances it is the secondarily invading *streptococcus pneumococcus staphylococcus B mucosus capsulatus* or *H influenzae* From the standpoint of chemotherapy the bacteriologic mechanism is of extreme importance and explains the extraordinary efficacy of the antibiotics in prophylaxis and treatment

Clinical Manifestations

The clinical manifestations of otitis media leave little doubt as to the presence of the complication The patient first notes *fullness in the ear*

with some *diminution in hearing* Later *pain* develops and increases until it is extremely severe As previously emphasized the condition requires differentiation from a *bullous myringitis* (p 2144) in which the pain is more intense vesicles are seen along the canal wall and the exudate is characteristically hemorrhagic

The changes in otitis media are best observed by repeated examinations of the drum The earliest phase is that of the *catarrhal inflammation* Unless the process undergoes resolution the *purulent stage* is entered this may be terminated by *resolution* or *perforation* with or without complications

Otitis Media Catarrhalis Acuta—In the catarrhal phase of an acute otitis media the earliest otoscopic change is revealed at the *handle of the malleus* This area becomes bright red and dilated vessels are observed in the immediate environs the whole membrane becomes thick and loses its glossiness and the *light reflex* is distorted or lost As the inflammation advances the *posterior half of the drum head* bulges the landmarks are obliterated and a *fluid level* may be observed through the membrane or air cells shine through the drum head The *conduction of sound* is impaired for lower tones The *Rinne test* (p 2017) is negative the Weber test (p 2017) refers the sound to the affected side and bone conduction is intensified

In favorable instances the infection does not progress further and restitution to normal is observed over the course of the next several days

Otitis Media Purulenta Acuta—With advance of the catarrhal inflammation to the purulent phase the *local symptoms* are intensified and *constitutional manifestations* make their appearance The *temperature* rises higher there may be slight *chilliness* or in infancy a *convulsion* The *leukocyte count* rises and the patient appears querulous and irritable Examination of the drum at this time reveals an increase in the changes described in the catarrhal inflammation Additionally behind the malleus and slightly above the handle there may be *pointing* preliminary to *perforation*

Resolution is unlikely once the condition has advanced to this stage The inflammatory process usually progresses to *spontaneous perforation* unless it is altered by anti infective therapy or *surgical paracentesis*

Perforation—Opening of the drum whether spontaneous or deliberate gives sudden relief of symptoms The *discharge* at first is thin and pink but later appears thick and purulent Spontaneous perforations may be inadequate and fail to relieve pain or produce the amount of drainage that follows a generous incision

Following perforation of the drum the ear discharges for a variable time In favorable instances the secretions diminish local and constitutional manifestations abate the perforation heals and the drum head resumes its normal appearance except for the presence of the *whitened cicatrix* Hearing returns to normal within a few weeks after the sealing of the perforation

Complications

The complications of acute otitis media are varied and of such gravity that *specialist consultation* is mandatory upon their slightest suspicion The repertory includes *mastoiditis labyrinthitis petrositis facial paralysis*

otogenic meningitis (p 2148) *otogenic brain* abscess in the frontal or temporosphenoidal lobes or the cerebellum *lateral or cavernous sinus thrombosis* and *phlebitis of the jugular vein*

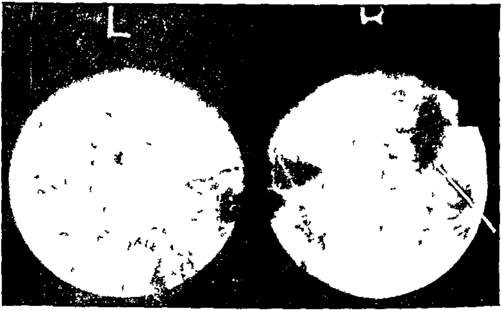


Fig 491 —Left view illustrates a normal pneumatized mastoid process Right view illustrates a cholesteatoma *



Fig 492 —Roentgenogram showing an acute coalescent mastoiditis *

It is the obligation of the practitioner to recognize the implications of otitis media so that *he may refer his patient promptly to the otologist*

Mastoiditis —Suspicion of mastoid involvement is aroused when the practitioner observes any one of the following phenomena alone or in combination

* Ersner in Jackson and Jackson Diseases of the Ear Nose and Throat

1 Persistence of the aural discharge for more than 10 days
2 Progressive or sudden increase in aural discharge
3 Bulging or sagging of the postero superior osseous wall
4 The appearance of nocturnal hemicrania on the side of the otitis media The pain may be referred behind the eye or directly over the mastoid
5 The appearance or increase of sensitivity over the mastoid bone the zygoma or in the region of the digastric triangle (Bezold mastoiditis)
6 Sudden cessation of aural discharge with increase in pain and recurrence or exacerbation of constitutional manifestations particularly fever or leukocytosis
7 Thickening of the aural discharge
8 Reappearance of the aural discharge immediately after the auditory canal has been wiped dry
9 A high concentration of calcium in the aural discharge indicating bone destruction
10 Roentgen evidence of destruction of the mastoid cells as compared with the sound side or with serial radiographs
11 Redness and swelling of the mastoid antrum tip or cellular tissues of the digastric triangle
12 Isolation of *B mucosus capsulatus* or pneumococcus type III from the aural exudate

Labyrinthitis—With involvement of the labyrinth the patient develops vertigo ataxia nausea vomiting and total loss of hearing During the acute phase there is a tendency to lie on the unaffected side The additional development of fever or headache suggests meningeal spread and requires the performance of lumbar puncture It is well at this time to caution the family that even with successful therapy permanent deafness is to be anticipated

Petrositis—Infections of the petrous pyramid are most frequent during the first ten years of life The causative organisms usually are the *Streptococcus haemolyticus pneumococcus types III* and *IV* and staphylococcus hemolyticus

The most marked presenting symptom of petrositis is retro orbital or peri orbital pain that is especially marked at night The appearance of this type of nocturnal distress two or four weeks after a mastoidectomy is almost pathognomonic With the onset of pain the aural discharge increases temperature rises and there is weakness or paralysis of the external rectus (Gradenigo s syndrome) from paralysis of the sixth cranial nerve The leukocyte count increases but the spinal fluid findings reveal no abnormality Specially devised roentgenograms may provide conclusive evidence of the presence of the petrous involvement Extension of the infection to the meninges and an additional complication of an otogenic meningitis greatly increase the gravity of the clinical situation

Facial Paralysis—Acute middle ear infection may be complicated by an ipsilateral peripheral facial nerve paralysis This complication may occur early or late in the course of suppuration If the nerve weakness appears during the first few days it may be assumed that the involvement is

otogenic meningitis (p 2148), *otogenic brain* abscess in the frontal or temporosphenoidal lobes or the cerebellum *lateral or cavernous sinus thrombosis* and *phlebitis of the jugular vein*

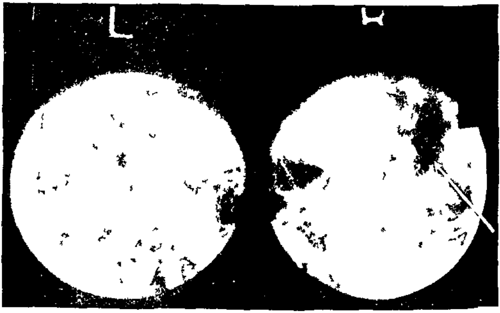


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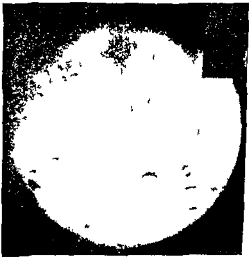


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* Ersner in Jackson and Jackson Diseases of the Ear Nose and Throat

of the mastoid bone may become red swollen and slightly tender The deep cervical glands over the internal jugular vein may become enlarged and tender Often these are a deciding factor as to which side the surgical approach should be made in cases of bilateral acute otitis with phlebitis

The cardinal symptoms of sinus phlebitis are chills and fever with wide swings in the temperature curve The chills may occur daily or less fre quently A bacteriemia is invariably present and a positive blood culture should be obtained in 95 per cent of the cases if carefully taken The optimum time to obtain a positive culture is during the rise of the tem perature after the chill The spleen may be palpable as in any sepsis The hemoglobin goes rapidly down and the general condition of the patient becomes progressively worse Metastatic foci in the joints are not uncom mon and are to be regarded as just as much an evidence of sepsis as a positive blood culture Papilledema or optic neuritis occurs in about 20 per cent of the cases and is a valuable aid in diagnosis It may occur in either eye

With the use of anti infective agents in combatting the sepsis a de cided modification of the classical clinical course can be expected The signs and symptoms of sepsis may not be manifest during the adminis tration of the drug The blood culture may be rendered sterile by sulfo-namide or penicillin Occasionally the blood plate will show a growth only after forty eight to seventy two hours and hence the plate must not be discarded if no growth appears for the first few days Even minute quan tities of the antibacterial substances seem to inhibit the growth tem porarily

Masking of the symptoms may continue until the drug is withdrawn During this interval the phlebitis may well be extending to involve the petrosal and lateral sinuses beyond the torcular or the internal jugular vein into the mediastinum When the drug is finally stopped a recurrence of chills and fever with other evidences of sepsis may return in a more severe form It would appear more logical not to use the antibacterial substances until the diagnosis of sepsis has been definitely established preferably by a positive blood culture With a known organism the drug should then be given in adequate doses preoperatively The sigmoid sinus should then be obliterated well beyond the gross evidence of phlebitis Free bleeding is to be obtained posteriorly from the lumen of the sigmoid or the lateral sinus The jugular bulb is then occluded if not already thrombosed by dis ease and the internal jugular vein ligated Postoperatively the antibacte-rial drug is continued and supportive measures preferably repeated blood transfusion are administered

Treatment

The treatment of uncomplicated otitis media involves the inauguration of prophylactic and curative *therapy* with sulfonamide (p 88) penicil lin (p 106) or both Parenteral deposits of penicillin may be supplemented by penicillin nebulization (p 2118) and aerosolization using solutions of as many as 100 000 units to the cc

The local application of *heat* is usually grateful *steam inhalations* and the use of va oconstrictors in the nose may relieve some of the obstructive

within the middle ear cavity and the condition may be alleviated by early myringotomy combined with anti infective therapy A paralysis which becomes manifest during or after the second week is probably due to involvement within the substance of the mastoid bone along the fallopian canal The nerve involvement indicates progressive bone destruction within the mastoid and indicates the necessity for early surgical intervention If the diseased cells can be completely exenterated normal function may be recovered

In a chronic suppurative otitis media the appearance of peripheral nerve palsy is an indication of progressive erosion of the mastoid A complete and *radical mastoidectomy is to be promptly performed as the only* method by which recovery can be accomplished A contralateral central nerve paralysis during an otitis suggests the presence of a temporo phenoidal abscess

Otogenic Meningitis—The advent of an otogenic meningitis is heralded by the development of signs of meningeal irritation The patient complains of headache and the practitioner notes stiffness of the neck and the presence of the Kernig and Brudzinski reflexes Lumbar puncture reveals increased pressure pleocytosis turbid fluid and demonstrable bacteria by stain and culture

Otogenic Brain Abscess—Otogenic brain abscess is suspected when the patient complains of persistent headache with nausea and vomiting The ophthalmoscope reveals dilatation or prominence of the retinal veins blurring of the optic disk or actual papilledema Localizing intracranial symptoms include oculomotor paralysis paralysis of the ipsilateral sixth nerve (Gradenigo s syndrome) paralysis of the facial nerve nerve deafness aphasia hemianopia nystagmus dizziness vertigo restlessness excitability convulsions drowsiness change in disposition coma localized cranial tenderness and pupillary disturbances

Otogenic Venous Complications—Invasion of the lateral and sigmoid cranial sinuses of the skull or of the jugular bulb may occur as an early or late complication of acute otitis media Primary jugular bulb phlebitis usually happens early and is the result of direct extension of the infection into the jugular dome through the floor of the middle ear In these instances the mastoid bone is sclerotic and extension into the jugular bulb occurs before the mastoid cells become diseased Extension into the jugular bulb may occur by lymphatic channels or occasionally by a dehiscence in the floor of the middle ear

Phlebitis of the sigmoid and lateral sinuses most often happens as a sequel to mastoiditis and may or may not be accompanied by a perisinus abscess Occa ionally it is a post mastoidectomy complication The phlebitis may extend from the sigmoid sinus down to the jugular bulb and along the *course of the internal jugular vein By retrograde thrombo is or ex*tension the lateral sinus may become diseased as far back as the torcula

The phlebitis may be either dural or obdurating In the former brief bleeding is encountered when the cranial sinus is opened whereas in the latter only an occluding thrombus is found The lumen of the cranial sinus may be completely obliterated

By extension of the infection the emissary vein may become thrombosed In such instances the surrounding area over the posterior portion

Safeguards—The fear of clouding complications must not deter the practitioner from administering anti-infective agents upon the slightest evidences of acute otitis media. To safeguard the situation thoroughly serial roentgenograms of the mastoid cells provide incontrovertible evidence of what is transpiring in this locality; the symptoms and signs of complications elsewhere outlined (p 2147) are sought by subjective and objective scrutiny; on the appearance of any suspicion of untoward happenings the consultant otologist is summoned.

Surgery—With or without chemotherapy the *bulging* ear drum furnishes an indication for a liberal *paracentesis* (p 2037); small spontaneous perforations must be enlarged to provide adequate drainage.

Upon the suspicion of complications the judgment of the attending otologist is followed as to procedure. Often it is impossible to determine just how much surgery is required until the field is exposed. The mastoid cells may be treated by *simple* or *radical procedures*. It may be necessary to *expose the lateral sinus, ligate the jugular vein* or *drain an abscess* in the epidural region, the cerebrum or the cerebellum. Each of these procedures is preceded and followed by intensive chemotherapy using *sulfonamide* (p 88) or *penicillin* (p 106) alone or in combination.

It may be necessary to operate on one or both sides; at times after one side has subsided the other becomes activated, again demanding surgery. The cerebral and cerebellar abscesses may not be recognized until a considerable period after the subsidence of the otological inflammation so that the surgical procedure is not attempted until the original insult has completely healed.

Discharge Examination—After recovery from otitis of even mild severity the patient is requested to report for a complete survey of the upper respiratory passages. *Nasal obstructions* are corrected, a *deviated septum* is resected and enlarged *adenoid tissues* (p 2140) and *tonsils* (p 2153) are removed. The patient is warned concerning the practice of blowing the nose; only one side is blown at a time and a gentle sniff is all that is permitted. Upon recurrence of the upper respiratory infection the patient is cautioned to remain at home and keep the nasal passages as clear as possible by the use of steam inhalations and the judicious instillation or spraying of a vasoconstrictor substance.

CHRONIC OTITIS MEDIA

Subacute and chronic otitis media follow the neglected or imperfectly treated middle ear infection. The continuation of the process is favored by the presence of those factors which produce *nasal obstruction* (p 2732).

Clinical Manifestations—Most patients with subacute or chronic middle ear infection complain of *chronic aural discharge, tinnitus, head noises, fullness in the ears* and slowly increasing *deafness*.

Local examinations may reveal the presence of foul smelling aural discharge and the canal is occasionally macerated by irritation of the secretion. After thorough cleansing a perforation with thickened edges is seen. The perforation most commonly encountered is the so called kidney shaped ventral perforation confined within the limits of the tympanic membrane. In such central perforation the short process of the malleus is usually visible and the clinical course is apt to be benign. The more

phenomena which favor the entrance of the material into the eustachian tubes

Chemotherapy—The advent of specific therapy with *sulfonamide* and *penicillin* has resulted in an extraordinary decrease in the incidence of acute otitis media and many of the severe and often fatal complications have already become clinical curiosities Paracentesis of the ear drum formerly one of the most frequent operative procedures is now rarely

DIFFERENTIAL DIAGNOSIS OF

Discharge or Bleeding from the Ear (Otorrhea)

Aural discharge is a serious presenting symptom at all times Under the most favorable circumstances the discharge represents drainage of material from the canal or ear drum without an important threat to the patient s life Material which is derived from the middle ear or mastoid process is indicative of serious difficulty bleeding associated with skull fracture exposes the patient to the perils of otogenic meningitis and other intracranial complications

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Impaction of Cerumen	With otitis externa and local weeping
Otitis Externa	Exudative discharge with offensive odor often mycotic (p 3305) Drum intact
Rupture of Drum	From direct or indirect trauma Intense pain with bloody discharge Note perforation
Furunculosis	Purulent discharge after rupture of pyoderm Drum intact
Acute Otitis Media	Serosanguineous and later purulent discharg with obvious perforation of drum
Acute Myringitis	Sudden discharge of serosanguineous material with relief of pain Shreds of broken bulla visible on drum but no evidence of perforation
Chronic Otitis Media	Persistence of purulent aural discharge which may be profuse scant constant or intermittent Fetid odor suggests cholesteatoma with necrosis of bone Refer to specialist and obtain x rays of mastoid area
Mastoiditis	Persistent otorrhea with x ray evidences of local osteomyelitis (p 2146) Refer to specialist
Fracture of Base of Skull	*With perforation of drum bloody discharge is* noted from ear with clear cerebrospinal fluid Institute intensive therapy with anti infective agents (p 106)

necessitated and many prominent otologists perform only an occasional mastoid operation

Masked Complications in Chemotherapy—The beneficences of chemotherapy unfortunately are not wholly without entries on the unfavorable side of the ledger As with suppurative processes elsewhere in the body complications may be obscured by the therapeutic agent suppurative and destructive inflammations may progress while the patient shows the usual evidences of improvement On cessation of medication there is a violent exacerbation of symptoms with ominous implications

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treacherous type of perforation is the so called marginal one in which the surrounding eroded bone is included in the perforation with the adjacent tympanic cavity These marginal perforations are almost invariably accompanied by foul smelling discharge They are often situated in Shrapnell s membrane and are the ones most frequently associated with marked impairment of hearing and otitic complications The drum may be obstructed by granulomatous or cholesteatomatous tissue which is especially *prone to occur with marginal perforation*

Patients with chronic otitis media must be cautioned against swimming All known devices including ear stoppers are not to be trusted since complications of otitis media chronica are more frequent after swimming

Middle Ear Deafness—Ordinarily middle ear deafness involves *loss of the lower tones of the scale* with retention of middle and upper tones the *Rinne test* (p 2017) is negative the *Weber test* (p 2017) refers sound to the involved ear *bone conduction* is lessened *roentgenograms* of the mastoid region often reveal thickening or sclerosis of the cells

Treatment—Treatment consists of thorough cleansing of the external canal and perforated area in the drum Benzine and alcohol serve this purpose adequately Intensive and protracted antibiotic therapy merits trial using penicillin or streptomycin parenterally and by nebulization and aerosolization The sudden appearance of vertigo or hemicranial headache in a patient with an acute exacerbation of a chronic otitis should promptly arouse the suspicion of a progressive necrotizing process within the middle ear or mastoid cavity and calls for complete exenteration by a radical mastoidectomy

ACUTE MASTOIDITIS

See p 2146

ACUTE LABYRINTHITIS

See p 2147

ACUTE PETROSITIS

See p 2147

OTOGENIC MENINGITIS

See p 2148

OTOGENIC BRAIN ABSCESS

See p 2148

SINUS THROMBOPHLEBITIS

See p 2148

ACUTE LINGUAL TONSILLITIS

The lingual tonsil is situated at the base of the tongue It resembles the faucial tonsil except that it is possessed of much greater vascularity

Clinical Manifestations —Acute inflammation of the lingual tonsil is suspected when the upper respiratory symptoms are dominated by *acute pain* referred to the region of the larynx painful and difficult *deglutition* an exasperating unproductive *cough* that is worse when the patient reclines and *hoarseness* Ordinary methods of local examination disclose insufficient findings to explain the degree and persistence of symptoms but the *throat mirror* clearly reveals the acute inflammation of the lingual tonsil often with follicle formation

Acute lingual tonsillitis may be associated with severe *constitutional manifestations* and carries with it the threat of *laryngeal edema* (p 2101) *abscess of the lingual tonsil* or a *descending mediastinitis* (p 2293)

Treatment —The treatment of acute lingual tonsillitis follows along the lines of an *acute adenoiditis* (p 2139) Topical applications of a vasoconstrictor and a local anesthetic may give some transitory comfort

CHRONIC LINGUAL TONSILLITIS

Subacute or chronic inflammation of the lingual tonsil occurs much more frequently than is generally suspected Unless a *mirror examination* is made the condition is not diagnosed and the persistent symptoms lack adequate explanation

Clinical Manifestations —The most frequent complaints with chronic lingual tonsillitis are a constant *desire to swallow* the feeling of a *lump in the throat* *chronic cough* which is worse at night and often of a *paroxysmal nature* *uncertainty in voice control* with episodes of *hoarseness* the frequent necessity to clear the throat and recurrent attacks of *enlargement of the cervical lymph nodes* Singers actors and public speakers may suffer unevenness of performance and understandable emotional overtones as the result of this inconsequential lesion

Treatment —Chronic hypertrophy or inflammation of the lingual tonsil is best treated by reference to the surgeon for *cauterization* or *surgical removal* using a snare or guillotine

ACUTE PALATINE OR FAUCIAL TONSILLITIS

Acute palatine or faucial tonsillitis does not differ fundamentally in its etiology pathology or clinical manifestations from the other acute lesions of the upper respiratory passages

Etiology —The etiology of the acute faucial tonsillitis is only clarified with definitiveness by bacteriologic examination *Streptococcal invasions* (p 157) are more prone to cause a follicular and fibrinous exudate *diphtheritic membranes* (p 302) are more adherent and tend to produce bleeding after removal but the element of certainty requires identification of the causative organism in smears and preferably by cultural methods

Clinical Manifestations

Acute follicular tonsillitis is usually associated with considerable *enlargement of the cervical glands* *dysphagia* a distressing hacking *cough* continuous *hawking* and moderately severe or intense *constitutional symptoms* including an initial chill a striking elevation of temperature a leukocytosis and a certain amount of stiffness of the neck

Examination reveals brilliant redness of the tonsillar pillars some edema of the uvula and bulging redness and swelling of the faucial tonsils Often the tonsillar crypts are plugged with a yellowish white mass of pus and debris The follicles may coalesce and form a *fibrinous exudate which differs from the diphtheritic membrane in its easy separation and* the lack of bleeding when removed Large hypertrophied and acutely inflamed tonsils may meet in the median line and produce severe mechanical obstruction

Treatment

The treatment of acute *tonsillitis is conducted with a view to the long* range as well as the immediate problems

Specific Therapy—If there is a suspicion of a diphtheritic infection *antitoxin* (p 310) is given in liberal dosages (10 000 to 20 000 units) In nondiphtheritic invasion the authors administer intensive *therapy* with the *sulfonamides* (p 88) or *penicillin* (p 106), irrespective of bacterial findings It is our opinion that it is far better to hazard the occasional toxic manifestations of drug therapy than run the risk of initiating a rheumatic fever or of producing tissue changes that may result in later years in an *endocarditis* (p 1020) or a *nephropathy* (p 2362)

Palliation—*Local treatment* is merely palliative *Gargles* accomplish little *throat irrigations* are a nuisance although they may afford some symptomatic relief while *lozenges* impregnated with local anesthetic have only questionable and transitory value It is the authors experience that application of an ice collar and sips of iced or hot fluid accomplish as much relief as anything else External applications to the neck with inunctions of *oil of wintergreen* and wrappings of red flannel add only to the picturesqueness of the scene Liberal doses of *acetylsalicylic acid* (p 3839) and the *salicylates* (p 3340) may interfere with sulfonamide therapy analgesia is better effected by the prescription of *demerol* (p 3863) or a hypodermic of *morphine sulfate* or *dilaudid* (p 3854) at bedtime

Tonsillectomy—Following any serious attack of acute tonsillitis and certainly *after one which has been followed by any of the complications a tonsillectomy* is advised as soon as all of the acute evidences of infection have subsided The authors prefer *local anesthesia* except in uncooperative youngsters and in those who must have an associated *adenoidectomy* Tonsillectomy should be preceded and followed by intensive penicillin therapy (p 106)

Course and Complications

The course of an acute tonsillitis is usually toward subsidence within three to seven days Mildly persistent manifestations may be noted for an equal length of time

Despite the usually favorable course of an acute tonsillitis a wide variety of complications may be encountered These include mechanical obstruction *suppuration of the cervical lymph nodes spread of the infection* through the *eustachian tubes to the middle ear peritonsillar suppuration* the formation of retropharyngeal or parapharyngeal abscesses phlebitis of

the internal jugular vein a descending infection with acute laryngotracheitis (p 2164) or pneumonitis (p 2185)

Bacteremias and *septicemias* are encountered with distant sequels such as exacerbations of *rheumatic fever* (p 186) *acute glomerulonephritis* (p 2373) *acute arthritis* (p 2960) *acute osteomyelitis* (p 2930) and *pneumonitis* *Diphtheritic infections* are associated with *neurologic* and *myocardial consequences* elsewhere described (p 307)

Mechanical Obstruction —Mechanical obstruction in the course of an acute tonsillitis is most frequently encountered with *membranous diphtheria* Non diphtheritic tonsillitis occasionally causes obstruction but usually through *edema of the larynx* (p 2101) The patient requires hospitalization with intensive penicillin therapy constant steam inhalations are utilized after local sprays of vasoconstrictor substances The consultant laryngologist is summoned and it may be necessary to perform *scarification* and make preparations for *tonsillectomy intubation* or *tracheotomy*

Suppurative Cervical Adenitis —Suppuration of the cervical lymph nodes is presently an infrequent but serious complication of acute tonsillitis The patient complains of severe localized pain the overlying skin is often red and edematous and the involved gland or glands are tender and may be palpably fluctuant There is often an associated increase in the constitutional symptoms with elevation of fever leukocytosis tachycardia and some rigidity of the neck due to spasm of the overlying neck muscles

Suppurative cervical adenitis calls for *intensive penicillin therapy* Local applications of *hot compresses* are applied constantly *Roentgen therapy* (p 3796) may assist in localization The surgical consultant is requested to remain in attendance so that *incision* and *drainage* may be practiced immediately that respiratory embarrassment becomes apparent

Otitis Media —See p 2144

Peritonsillar Abscess (Quinsy) —Peritonsillar abscess is a localized suppurative infection between the capsule of the tonsil and the fascial wall of the constrictor muscle of the pharynx The disturbance almost invariably follows an acute follicular tonsillitis the infection of the tonsillar crypt extending through the capsule of the tonsil and into the peritonsillar space in the region of the supratonsillar fossa The abscess lies toward the upper pole of the tonsil and pushes the tonsil downward and mesially less commonly the abscess is situated somewhat beneath the tonsil displacing it forward with the main mass of the abscess presenting in the posterior tonsillar pillar

Clinical Manifestations —The presence of a peritonsillar abscess is suspected during the course of an acute follicular tonsillitis when the patient complains of *severe dysphagia difficulty in opening the mouth* and constant *pain in the throat* radiating through to the ears The *trismus* is due to spasm of the muscles of mastication The patient drools excessively saliva dribbles from the mouth and thick secretions accumulate in the throat The temperature fluctuates between 101° and 105 F cervical adenitis is common the leukocytes rise and the sedimentation rate may be increased

Local examination is difficult due to the inability of the patient to open his mouth Even an imperfect view reveals a hard red swelling of the peritonsillar region edema of the soft palate and tonsillar pillars and

displacement of the uvula to the opposite side The swelling may be maximal in the tonsillar area or in the region of the posterior tonsillar pillar With suppuration in the lower pole of the tonsil there may be marked edema of the tongue epiglottis and hypopharynx as well as supraglottic edema of the larynx

As the suppurative process continues localization of the infection occurs pus is formed and fluctuation becomes evident The abscess may rupture spontaneously through the anterior pillar or one of the crypts and discharge foul smelling pus

Treatment—With the recognition of the development of a quinsy specialist consultation is warranted since early *incision* and *drainage* fortified by *preoperative and postoperative chemotherapy* may save the patient devastating local and distant complications In an emergency the practitioner may be compelled to perform the incision without expert assistance but the procedure is not as simple as it seems there is a danger of injury to arteries of significant size producing hemorrhage and an inadequate opening may be followed by widespread tissue sloughs with secondary bleedings from the walls of eroded vessels

Before operation the anti infective agents are given if they have not already been prescribed A well laid incision is followed by almost instant relief of symptoms The line of the incision is anesthetized by the local application of 20 per cent cocaine with epinephrine General anesthesia is avoided and provisions are made for continuous suction so that none of the liberated pus is aspirated

Despite best efforts the procedure is always painful from the pressure of the scalpel on the tense abscess cavity With children as soon as the incision is completed the youngster is turned upside down to prevent aspiration As soon as possible drainage is assured by stretching the incision with a hemostat At each dressing the opening is perpetuated by the use of a probe

In adults there has been a recent trend toward the treatment of peritonsillar abscess by local dissection of the involved tonsil Enucleation is easily performed there is minimal bleeding and prompt relief of symptoms The procedure should be preceded and followed by chemotherapy with the sulfonamides or penicillin (p 106)

Retropharyngeal Abscess—Retropharyngeal abscess which occurs most often in infants and children is due to involvement of the retropharyngeal lymph nodes which lie between the posterior pharyngeal wall and the prevertebral fascia Infections of the retropharyngeal nodes commonly result from acute upper respiratory infections such as *tonsillitis* and *paranasal sinusitis* Less commonly the lesion accompanies infections of the *posterior pharyngeal wall* and suppuration in the *petrous pyramid* (p 2147)

Clinical Manifestations—In infants and young children retropharyngeal abscess is suspected in the presence of *dysphagia* (p 1722) and *dyspnea* (p 2016) Older children and adults complain of *local pain* and *dysphonia* (p 2160) *Constitutional symptoms* increase and the appearance of the patient is unsatisfactory if not alarming

On examination a *boggy inflammatory mass* is seen and felt in the retropharyngeal area below the level of prominence of the second cervical vertebra A malformation of the upper cervical vertebrae causing a bulge

into the pharynx may be mistaken for the retropharyngeal abscess It is differentiated by the hard firm feel which contrasts with the tender fluctuant swelling of suppuration

Treatment—The treatment of the retropharyngeal abscess follows the principles outlined in the management of quinsy (p 2156) *Specialist consultation* is more urgently required since injury to vessels is likely to result from an injudicious incision

Parapharyngeal Space Infection—The parapharyngeal space is separated from the peritonsillar space by the pharyngeal wall Infection in the parapharyngeal space arises from lesions in the surrounding structures principally peritonsillitis retropharyngeal abscess infection around the molar teeth or downward spread from the petrous pyramid It may also occur from suppurative adenitis of the parapharyngeal glands secondary to tonsillitis

Clinical Manifestations—The early signs and symptoms of parapharyngeal abscess are very similar to those of *peritonsillar abscess* (p 2155) *Dysphagia dysphonia fever otalgia* and *trismus* are encountered Examination of the pharynx reveals a *diffuse bulge* in the pharyngeal wall which differs from the localized lump caused by the peritonsillar abscess A tender swelling in the neck just behind and below the angle of the jaw is noted

As the infection in the parapharyngeal space extends the swelling of the neck may reach the mastoid and parotid regions and progress down to the clavicle Spread to the laryngeal region may cause edema and asphyxia Jugular vein phlebitis cavernous sinus thrombosis and erosions of the arteries in the parapharyngeal space may occur

Treatment—The parapharyngeal space infections are relieved by prompt and extensive incision over the angle of the jaw followed by adequate drainage of the retromaxillary space

Phlebitis of the Internal Jugular Vein—Involvement of the large vessels of the neck may occur during the course of a peritonsillar abscess So-called *postanginal sepsis* is caused by extension of the inflammatory process to the wall of the jugular vein with production of a jugular vein phlebitis It may appear five to ten days after the peritonsillar abscess has begun to resolve the pharynx may appear completely normal by the time the signs of sepsis supervene Erosion of one of the large arteries in the peritonsillar region with resultant *hemorrhage* is an occasional complication Ligation of the external carotid artery may be necessary to stop the bleeding Intensive treatment with sulfonamide (p 88) and penicillin (p 100) is required

HYPERPLASIA OF THE FAUCIAL TONSILS

Tonsillar hyperplasia usually occurs as a manifestation of a generalized lymphoid diathesis As in the case of adenoid hyperplasia there is a tendency for regression in the amount of tonsillar tissue after puberty

In young children a large hyperplastic tonsil may cause *obstruction to breathing* and predispose to *upper respiratory and middle ear infections* The relationship to *focal infection* (p 42) is disputed The authors are included amongst those who elect to advise tonsillectomy as a *therapeutic*

test in otherwise inexplicable distant clinical phenomena of an infectious nature

Treatment—In the presence of significant symptoms *surgical removal* of the hyperplastic tonsil is indicated *Electrocoagulation* is an unsatisfactory procedure which adds to the difficulty of subsequent surgical removal *Roentgen therapy* is not desirable in tonsillar hyperplasia although it may be tried in recurrent hyperplasia of the lymphoid tissue of the nasopharynx

CHRONIC FAUCIAL TONSILLITIS

Chronic tonsillitis may or may not be associated with recurrent attacks of acute inflammation The chronicity of the inflammatory process may be inherent in its nature On rare occasions the lesion is *tuberculous* (p 252)

Clinical Manifestations—Chronic tonsillitis may cause local, focal allergic and constitutional symptoms The *local complaints* are usually minor and consist of mild soreness of the throat a scratchy sensation in the pharynx fetid breath and tenderness or swelling of the cervical lymph nodes

The *focal and allergic consequences* of chronic tonsillitis are difficult to establish It is our practice to look with suspicion on the tonsillar region in attacking the management of such problems as recurrent attacks of *rheumatic fever* (p 186) in *arthralgias* (p 2802), *myalgias* (p 2894), *arthropathies* (p 2855), *allergies* (p 547) *uveitis* (p 1632), *keratitis* (p 1626) *scleritis* (p 1631) the *erythemas* (p 3161) and *purpuras* (p 3423) and the *nephropathies* (p 2362) If other obvious foci of infection and etiologic factors are absent the authors perform tonsillectomy as a *therapeutic test* and observe the consequences

Chronic tonsillitis in our opinion is capable of producing *systemic disturbances* such as general malaise failure to gain weight and strength low grade pyrexia and continued tachycardia

Physical Examination—The appearance of the chronically infected tonsil is often most deceptive The structure appears ugliest when its *deep crypts* are filled with a *caseous material* composed of desquamated epithelium pus and bacterial bodies It is our experience that the relatively innocent appearance of the *buried and atrophic tonsil* has much more important connotation Often the structure cannot be visualized until the anterior pillar is retracted and then it appears as a small buried nubbin with a smooth shining surface On removal and section the practitioner is often amazed to find that the shiny surface is a shell of an abscess cavity containing an organism not represented by surface smears made preoperatively On occasions the histological appearance clearly reveals the tuberculous nature (p 252) of the chronic inflammatory process

Treatment—It is the opinion of the authors that *tonsillectomy* should be performed when there are local focal allergic or constitutional symptoms that may possibly stem from chronic tonsillitis We prefer to advise many unnecessary tonsillectomies rather than to be conservative in a single instance in which neglect might result in irreparable tissue damage and invalidism Under local anesthesia the procedure is safe with minor incapacitation the possible benefits are out of all proportion to the prob

able hazards The organism that is obtained after section of the tonsil is grown and utilized for skin testing and vaccine therapy at a later date

Patients with *rheumatic fever* (p 186) or evidences of *endocarditis* (p 970) are given *preoperative and postoperative chemotherapy* to prevent the development of a *subacute bacterial endocarditis* (p 1001) following the operation

HYPERKERATOSIS OF THE TONSILS

Hyperkeratosis of faucial and lingual tonsils occurs in young adults and occasionally disappears spontaneously within two to three years Horny plugs arise from the mucosa fill the tonsillar crypts and project as white points above the surface A variegated bacterial flora is found including saprophytes and an occasional *Leptothrix*

Hyperkeratosis of the tonsil is usually *asymptomatic* but local rawness and burning or an irritative cough may be noted The patient often consults the physician because the appearance of the spots has caused alarm

With persistent symptoms and evidence of chronic infection removal of faucial and lingual tonsils is advised

CALCULUS OF THE TONSILS

Calculus of the tonsils occurs as a result of longstanding retention in a closed crypt The deposition of calcium and magnesium salts in a mass of desquamated epithelium mucus and pus produces a hard stony mass which may cause low grade irritation of the pharynx recurrent episodes of sore throat and otalgia

The stone is *removed* by slitting the overlying tissue If there is chronic tonsillar infection *tonsillectomy* should be performed

ACUTE EPIGLOTTITIS

Acute inflammatory involvements of the epiglottis occasionally accompany *acute faucial tonsillitis* inflammation or abscess of the *lingual tonsils pharyngitis* and *laryngitis* The involvement is suggested by the rapid onset of moderate to severe *dysphagia Movement of the tongue* is painful there may be varying degrees of *dyspnea* Mirror examination shows the presence of a swelling that overlies the anterior portion of the epiglottis On rare occasions the condition goes on to the formation of an abscess

Treatment —Some symptomatic relief is afforded by external use of an *ice collar* and *hot irrigations* of strong tea or saline solution An attempt may be made to spray the area locally with 2 per cent cocaine hydrochloride containing 1 1000 epinephrine It is a wise precaution to hospitalize the patient Obstruction to the airway from increased edema may require *scarification* by the laryngologist or the performance of a *tracheotomy*

ACUTE LARYNGITIS

Acute laryngitis usually is observed in association with *acute nasorhinopharyngitis* It may also occur without upper respiratory infection as an initiating disturbance in *pertussis* (p 278) *influenza* (p 396) *measles* (p 409) *tracheobronchitis* (p 2165) and *pneumonitis* (p 2185)

DIFFERENTIAL DIAGNOSIS OF

Hoarseness

Hoarseness is encountered frequently as a transitory complaint due to misuse of the voice or an upper respiratory infection Persistence of the affliction beyond a few days requires immediate reference to the specialist for laryngoscopy which may reveal the early stages of a serious lesion still amenable to therapy

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	Hysterical dysphonia Examinations normal
Physical and Chemical Trauma	Misuse of voice With intractable cough Inhalation of irritant gases and vapors Impaction of foreign body Postnasal drip from infections of nose adenoids sinuses faucial or lingual tonsils Perform anterior and posterior rhinoscopy (p 2021) Get sinus x rays and refer to specialist for diagnostic lavage
Neurogenic	Secondary to lesions of central nervous system such as tabes cerebral thrombosis or hemorrhage and multiple sclerosis Supplement neurologic examination with Wassermann and spinal fluid analysis (p 3734) Paralysis of superior or recurrent laryngeal nerves. Get chest x ray for pressure lesions Refer to specialist for direct laryngoscopy
Local Infections and Inflammations	With faucial and lingual tonsillitis peritonsillar and retropharyngeal abscesses May cause edema of larynx and obstruction to air way Acute and chronic laryngitis Get local spreads and cultures especially for C diphtheriae (p 302) Get biopsy particularly for M tuberculosis Order Wassermann and note effects of specific therapy (p 337) In angioneurotic edema try sprays of epinephrine and prepare for scarification (p 3349) In membranous infections and other lesions blocking airway prepare for intubation or tracheotomy (p 3958)
Neoplastic	*Benign and local tumors of cord* Refer to specialist for direct laryngoscopy and biopsy
Circulatory	Aortic aneurysm or enlarged left auricle of mitral stenosis causing recurrent paralysis
Hemic	Hemorrhage of cord from trauma or in bleeding diatheses Get hemogram and check bleeding and coagulation times (p 3706)
Thyrogenic	From pressure of goiter Injury to recurrent laryngeals during thyroidectomy
Metabolic	Laryngismus stridulus in rickets Note effects of vitamin D and calcium (p 2850) Myxedema of cord in hypothyroidism. Try thyroid extract (p 1189) Acromegaly of cord in anterior *pituitary disease*
Muscular	Weakness in myasthenia gravis Note effect of neostigmine (p 2886)

A *predisposition* to laryngeal infection occurs in those who are exposed to irritating vapors and gases habitual smokers those who misuse the voice in singing or public speaking in alcoholics and particularly in conjunction with chronic paranasal sinusitis (p 2131) and lingual tonsillitis (p 2152)

Clinical Manifestations —The presenting clinical manifestation of laryngitis is a *change in voice* The sounds become raspy and of low pitch *hoarseness* progresses to the point of complete *aphonia* and there is a tickling feeling in the throat and a constant desire to *cough* Local pain is encountered in association with *dysphagia*

Laryngeal examination discloses engorgement and congestion of the mucous membrane with dilatation of the superficial blood vessels the true cords appear injected and their free borders present a rounded appearance a certain amount of edema of false and true cords is usually discernible

Membranous Laryngitis —Membranous laryngitis arouses the immediate suspicion of a *diphtheritic infection* (p 302) Smears and cultures are taken promptly the patient is *institutionalized diphtheria antitoxin* (p 310) is administered *Systemic chemotherapy* with *penicillin* (p 106) is inaugurated and the further course of the treatment program is dependent upon the bacteriological report A positive culture revealing the diphtheria organism demands intensification of antitoxin therapy In the presence of invasion with other organisms however the antitoxin is discontinued but chemotherapy is further pursued

In addition to specific therapy the mechanical factor of obstruction may give rise to an urgent surgical problem The patient is removed to a hospital where a specialist is available who is skilled in the technic of *intubation* and *tracheotomy*

Vesicular Laryngitis —Vesicular laryngitis is most often of *herpetic origin* (p 434) Rupture of the vesicles results in the formation of a shallow ulcer The condition may be exquisitely painful but it is rarely associated with mechanical disturbances and requires only palliative treatment

Treatment —The treatment of a simple acute laryngitis consists in palliation The patient is urged to observe silence the room is kept warm and moist by the continuous use of a steam kettle Nebulization (p 2118) and aerosolization (p 2041) with penicillin merit trial

An attempt is made to attack the more fundamental paranasal sinusitis or the lingual tonsillitis (p 2153) With the appearance of edema or dyspnea the patient is institutionalized and a consultant is held available for *scarification* or *tracheotomy* if indicated

TUBERCULOUS AND OTHER FORMS OF CHRONIC LARYNGITIS

Chronic laryngitis occurs in *catarrhal hypertrophic polypoid* and *atrophic* forms Most often it accompanies other forms of chronic upper respiratory infections such as *rhinopharyngitis paranasal sinusitis* (p 2131) and *faucial or lingual tonsillitis* (p 2152) It is prone to occur with chronic irritations such as alcoholism excessive smoking mi use of the voice and exposure to irritant gases and fumes in industry

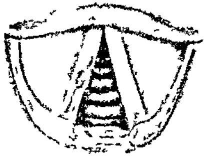


Fig 493—Early tuberculosis of the left vocal cord Thickening in the posterior commissure is a simple hyperplasia and not tuberculous

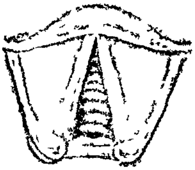


Fig 494—Early lesion of the left vocal process one of the most pathognomonic and characteristic early lesions

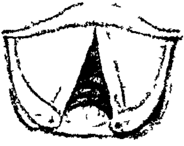


Fig 495—Beginning tuberculoma of the posterior commissure Note differences between the appearance in this case and that in Figs 493 and 494 *

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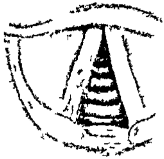


Fig 493 —Early tuberculosis of the left vocal cord Thicke
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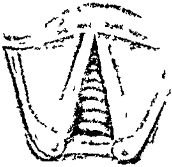


Fig 494 —Early lesion of the left vocal process one of the most path
acteristic early lesions



Fig 495 —Beginning tuberculoma of the posterior commissure Note differences between th
appearance in this case and that in Figs 493 and 494

Jackson and Coates The Nose Throat and Ear and Their Diseases

ing nature of the infection soon becomes apparent from the subglottic narrowing which is accompanied by *dyspnea inspiratory stridor* and *cyanosis* *Restlessness* and *anxiety* further indicate the possible onset of a progressive *anoxemia*

Croup is usually associated with *severe systemic manifestations* including hyperpyrexia tachycardia and severe toxemia With increasing laryngeal obstruction supraclavicular and intercostal retractions are noted The child occasionally expectorates a thick viscid exudate with temporary relief of obstructive symptoms which are apt to be most severe during the night

Laryngoscopy —Mirror examination reveals acute congestion of the laryngeal mucosa most marked in the *subglottic region* where a bilateral sausage-shaped swelling may produce marked narrowing of the lumen As the edema progresses exudate may collect and occasionally a *membrane* is formed which may or may not be diphtheritic

The *diphtheria membrane* is characteristically firmly attached and its removal leaves an ulcerated bleeding surface the *nondiphtheritic membranes* are more likely to be loosely attached and easily removed These clinical criteria are not absolute and the nature of the invading organism is determined definitively only by bacteriological investigation

Treatment —The child with croup requires *institutionalization* On suspicion of a diphtheritic invasion specific *antitoxin* (p 310) is administered together with systemic doses of *penicillin* (p 106) The further course of specific therapy is dependent upon the bacteriological diagnosis Serum is continued if bacilli are identified but reliance is placed on chemotherapy alone if the organism is not of the Klebs Loeffler variety

Meantime the child is placed in a *steam tent* which accomplishes great relief Most pediatricians favor the administration of small doses of *ipecac* (p 883) for an expectorant action The authors however are among those who fear to add nausea to the child s already sufficient difficulties and prefer the administration of the more palatable *Liquor Ammoniae Anisatus* of which 20 to 30 drops may be given in one quarter glass of warm water every two hours

If stridor is progressive and there are symptoms of anoxemia the specialist attempts to perform *laryngeal aspiration* by direct laryngoscopy *Oxygen therapy* (p 3827) may be of considerable value and may preclude the necessity for performing *intubation* or *tracheotomy* in instances of marked edema without much secretion In a *supraglottic edema* tracheotomy is much more urgent since the condition is treacherous and may result in a rapidly developing asphyxia

ACUTE TRACHEOBRONCHITIS

Acute tracheobronchitis stands midway between the syndrome of the *common cold* (p 391) and attacks of *acute pneumonitis* (p 2185) The inflammatory process successively may produce rhinitis pharyngitis laryngitis and tracheobronchitis often with local areas of pulmonary infiltration which are demonstrable by roentgenograms

Etiology.—On the basis of clinical experience it seems likely that the *common cold tracheobronchitis* and *primary atypical pneumonitis of viral origin* (p 2188) are manifestations of the same or very similar disease proc

edema and infection of the laryngeal mucosa may lead to *herniation* or *prolapse of the ventricle* This accident may be precipitated by a violent cough or sneeze A pear shaped smooth edematous looking mass protrudes from the laryngeal ventricle and covers the true cords

Diagnosis —See *Hoarseness* (p 2160)

Treatment —Treatment is specialist province Polypoid and cystic swellings can be removed by indirect laryngoscopy

RHINOSCLEROMA OF THE LARYNX

See p 2109

ABSCESS OF THE LARYNX

Abscess of the larynx is an occasional sequel to an *upper respiratory infection* (p 2105) *tuberculous perichondritis scarlet fever* (p 171), *measles* or *typhoid fever* (p 225) The condition is suspected when there is intense localized *swelling* of a portion of the larynx with severe *pain* and considerable obstruction to swallowing and breathing

Treatment —*Palliative treatment* consists in the use of steam inhalations and of warm external compresses Intensive therapy with penicillin (p 106) is started If fluctuation is present the abscess requires *incision* and *drainage* by the expert laryngologist who must also be prepared to perform a *tracheotomy* if asphyxial signs develop in the pre- or postoperative period

PERICHONDRITIS AND CHONDRITIS OF THE LARYNX

Perichondritis and chondritis of the larynx may be secondary to suppurative infections They may follow stab or operative wounds or they may arise in the course of a tuberculous syphilitic, typhoidal streptococcal or diphtheritic invasion

The condition is characterized by local *pain hoarseness aphonia dysphagia cough dyspnea* and a *reflex otalgia* Mirror examination reveals a localized inflammation which may correspond to a point of external swelling redness and tenderness when the lamina of the thyroid cartilage is involved

Intensive chemotherapy with the *sulfonamides* or penicillin is required The specialist must be available for *incision and drainage* by the internal or external route and it may be necessary to perform a *tracheotomy* Later dilatation of the lumen may be required to prevent laryngeal stenosis

ACUTE LARYNGOTRACHEITIS (CROUP SUBGLOTTIC OR MEMBRANOUS LARYNGITIS)

Acute laryngotracheitis or croup is characterized by marked inflammatory edema in the *subglottic region* with or without membrane formation The disease occurs most frequently in children under the age of three and usually accompanies epidemics of *influenza* (p 396) *measles* (p 409) *scarlet fever* (p 171) or *diphtheria* (p 302) The lesion may follow aspiration of a foreign body (p 2046) or the inhalation of an *irritating gas* (p 744) with secondary bacterial invasion by the *Streptococcus haemolyticus the Staphylococcus aureus* or the *pneumococcus*

Clinical Manifestations —The clinical manifestations of croup are initiated with *coryza cough* and slight *hoarseness* As the inflammatory process progresses the *cough* becomes worse and is raspy in quality *The alarm*

the inflammatory process persists beyond two or three weeks a *tuberculous etiology* is suspected (p 252)

Acute tracheobronchitis may represent an allergic manifestation in association with a *bronchial asthma* (p 2101) It also accompanies chronic lesions especially *bronchiectasis* (p 2059)

Bacteriology—The sputum obtained from patients with acute tracheobronchitis does not usually reveal the preponderance of any single organism Cultures may contain green or indifferent streptococci diphtheroids *Micrococcus catarrhalis* staphylococci hemolytic streptococci and pneumococci but there is little substantial evidence that recognized bacteria have a primary or an important secondary role in the pathogenesis of acute tracheobronchitis

Clinical Manifestations—When an acute tracheobronchitis is superimposed upon the common cold the intensity of the constitutional symptoms is more severe the patient complains additionally of more *persistent cough* and *retrosternal or chest pain* (p 2080) At first the cough is dry and nonproductive it may have a barking character and appear in paroxysms especially at night when it interferes with sleep Later sticky and then looser purulent material is expectorated with less and less effort

In contrast to the annoyance of the cough the patient usually does not appear seriously ill and the temperature rarely rises above 101° or 102° F The respiratory rate is not significantly elevated there is no unusual tachycardia and physical signs are limited to coarse rhonchi and *rales without changes in the percussion note or breath sounds* Roentgenograms at most show isolated scattered infiltrations but no significantly visible areas of frank consolidation The hemogram is unchanged The sputum does not contain any single predominant pathogenic organism and carbolfuchsin *stains do not reveal any acid fast bacilli*

Ulceromembranous Tracheobronchitis—On rare occasions a nondiphtheritic ulceromembranous tracheobronchitis gives rise to alarming clinical manifestations often associated with *edema of the larynx* (p 2101) and episodes of *asphyxia* The *cough* becomes more constant and severe the patient appears *anxious cyanotic* and urgently ill the *respiratory rate* rises and the accessory muscles of respiration are called into play

Course—Attacks of simple acute tracheobronchitis usually subside within three or four days The cough becomes looser sputum is more profuse the febrile reaction burns itself out and the chest pain abates After the pyrexia has completely subsided and the patient resumes normal activity the cough may persist for several weeks During this time irritation of the pharynx and larynx may result in rupture of small blood vessels with blood streaking Under these circumstances a review of the chest *condition is indicated* A *temperature record is kept for a minimum* of three days (p 3484) smears and cultures are examined for spirochetes mycoses and fungi concentrated sputum is searched for the presence of tubercle bacilli (p 252) a roentgenogram is taken for its present importance and for its comparative value at a later stage

Diagnosis—The diagnostic problem in an acute tracheobronchitis is both immediate and long range The urgent question involves the extent of pulmonary *involvement and the determination of the* etiologic factor Roentgenograms are required to settle with definitiveness the presence or

esses Until the etiologic agents are more clearly identified the hypothesis serves as a working basis for the establishment of the therapeutic program

DIFFERENTIAL DIAGNOSIS OF

Stridor and Stertor

Noisy respiration is an arresting symptom which may be audible to patient as well as physician It may or may not be associated with dyspnea and other evidences of respiratory embarrassment

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Hysteria	Usually in females Disappears during sleep Physical examination normal
Webs of Larynx or Bronchi	Congenital lesions seen on bronchoscopy (p 204) Amenable to endoscopic therapy
Laryngismus Stridulus	*In rachitic children* Often associated with carpopedal spasm and Chvostek sign from associated tetany (p 723) Note effects of therapy with Vitamin D and calcium.
Congenital Stridor	*In children unassociated with rickets* or tetany Local examination normal Disappears *spontaneously*
Bilateral Abductor Paralysis	Usually after thyroidectomy Diagnose by laryngoscopy (p 2024) *Refer to laryngologist.*
Bronchospasm	In asthma Acute attacks with intervals of normality *Associated with ballooning of chest* prolonged expiration and generalized wheezes and rales *Relieved by epinephrine and allied* drugs
Pertussis	*Paroxysms of cough ending in inspiratory crow* followed by emesis Try x ray therapy
Compression	From goiter enlarged thymus or mediastinal swellings Get biopsy Consider surgery or x ray therapy
Intratracheal or Endobronchial Tumors or Foreign Bodies	Localized stertor often inspiratory if ball valve obstruction is formed Peanut whistle sound over foreign bodies *Observe endoscopically* and refer to specialist for removal
Inflammations and Infections of Respiratory Mucosa	Peritonsillar and retropharyngeal abscesses *Cellulitis of floor of mouth Prepare for incision* drainage and penicillin therapy (p 106) Membranous pharyngitis tonsillitis or laryngitis particularly diphtheritic Get *smears and cultures (p 53) Tracheolaryngo* bronchitis Prepare for intubation or tracheotomy (p 3958) Angioneurotic edema of uvula. May require scarification Pulmonary edema with death rattle Try oxygen (p 3827)

Acute tracheobronchitis occurs in systemic infections particularly *measles* (p 409) *whooping cough* (p 278) *typhoid fever* (p 225) *brucellosis* (p 314) *coccidioidomycosis* (p 499) and *malaria* (p 507) When

Etiology — The presence of chronic bronchitis predicates a pre-existent mechanical chemical infectious or allergic substratum The *mechanical predispositions include* the presence of a foreign body a bronchiectasis a stenosis of the lumen or an endobronchial neoplasm *Chemical factors* may be exposure to fumes in industry heavy smoking or pulmonary de positions of dust as in the various types of pneumoconiosis *Infectious agencies* include chronic paranasal sinusitis tuberculosis brucellosis and inva sions with the less common *fungi* and *moulds* *Allergic predispositions* embrace vasomotor rhinitis or bronchial asthma Chronic bronchitis oc curs also in *cardiac failure* (p 941) and in association with pleural lesions especially *empyema* (p 2222)

Clinical Manifestations — The chief symptom referable to a chronic bron chitis is the persistence of *cough* which may be dry or productive The chronic bronchitic inflammation of itself does not cause constitutional manifestations If such are encountered they must be attributed to sec ondary infection or some more fundamental etiologic factor Aside from diffuse rales heard equally over both chests physical and roentgeno graphic examinations reveal no findings that result directly from the chronic bronchitis in and of itself

The Sputum — The character of the sputum may suggest the origin of the disturbance Large quantities of *putrid* sputum which layers on stand ing point to a bronchiectasis *coal black sputum* is found in miner s bron chitis *eosinophiles* appear in the sputum of those who have an allergy *heart failure cells* and *hemosiderin crystals* intimate that there is chronic passive congestion *acid-fast bacilli* are discovered in tuberculosis direct examination of the sputum may reveal spirochetes or mycoses

Bronchiolitis Fibrosa Obliterans — A special variety of chronic bron chitis is the condition known as bronchiolitis fibrosa obliterans This syn drome is characterized by roentgenographic evidences that suggest a *miliary tuberculosis* (p 261) It may follow acute pulmonary infections associated with *measles* (p 409) and *scarlet fe er* (p 171) or it may be associated with the inhalation of *irritating gases* (p 744) There is a pos sibility that the lesion is in actuality a representation of a healed stage of a miliary tuberculosis activated by the intercurrent infection or irritation

The presenting clinical manifestations of bronchiolitis fibrosa obliterans are *intense dyspnea* (p 2016) and *cyanosis* The physical signs are meager in comparison with the roentgenographic appearance The diagnostic in vestigation is concerned with disclosing the possible presence of a *miliary tuberculosis* (p 261) or a *hematogenous carcinomatosis* (p 572) In the former condition *tubercle bacilli* are found in sputum gastric contents or stool The primary site for the malignant lesion is sought in the *stomach* and *large bowel* Since the primary neoplasm may be completely silent *gastric analyses* (p 3721) and *stool examinations* (p 3727) are required before and after *contrast roentgenographic examination*

In the absence of positive evidences of tuberculosis or malignancy a tempered prognosis is warranted since complete recovery may occur

Ulceromembranous Bronchitis — Ulceromembranous bronchitis is usu ally caused by the *fusospirochetes* (p 50) The sputum is fetid and pro fuse the bronchial inflammation often is associated with a more obvious *trench mouth* (p 1698) or *Vincent s angina* (p 355)

absence of significant *pneumonitis* (p 2185) The more frequent roentgenology is utilized as a diagnostic adjuvant, the more often will pneumonitis be revealed

Following recovery from an acute tracheobronchitis or during the course of a persistent infection it is important to determine the possible presence of underlying or predisposing factors These include *chronic paranasal sinusitis* (p 2131) an *allergy* (p 547), a *bronchiectasis* (p 2059) a *tuberculosis* (p 252) or a *brucellosis* (p 314)

Complications —Although the majority of patients with acute tracheobronchitis recover within a few days occasional complications are experienced The bronchitic phenomena may be mere local representations of a developing *typhoid fever* (p 225), *pertussis* (p 278), or *measles* (p 409) Later sequels include *pneumonitis* (p 2185) or *bronchiectasis* (p 2059)

Treatment —Symptomatic therapy is all that is required for the ordinary attack of acute tracheobronchitis The patient is kept in bed and *steam inhalations* are given under a hood for twenty minute intervals at least four times daily as an expectorant we favor *Liquor Ammoniae Anisatus* as previously described (p 2052) The authors oppose the uncontrolled uses of *opiates* (p 3853) except for a single dose given by hypodermic at bedtime with possibly one repetition during the course of the night Patients are instructed that coughing is necessary in order to excrete purulent material Their cooperation is urged during the daytime hours they are promised a hypodermic at bedtime in addition to the oral use of a hypnotic

We favor the use of penicillin (p 106) by deposit by nebulization (p 2118) and by aerosolization (p 2041) for patients who are severely ill those whose symptoms persist and those whose general condition is such that they cannot be refused the aid of any therapeutic modality that may possess virtue

In convalescence it is our practice to insist upon an office visit before the patient has resumed normal activity At this time the nose and throat are carefully surveyed and a roentgenogram taken for assurance that there is no pre existent or developing chronic pulmonary disease

Ulceromembranous Tracheobronchitis—The presence of ulceromembranous inflammation of the tracheobronchial tree or the suspicion of superimposed laryngeal edema requires that the patient be *institutionalized* under specialist observation *Oxygen therapy* is instituted and if necessary *positive pressures* are employed Steam inhalations are given an *expectorant* such as *Liquor Ammoniae Anisatus* is administered every two hours in doses of 30 drops diluted with one quarter glass of water The *opiates* (p 3853) are withheld if possible *Bronchoscopic investigation* is worthy of consideration if an expert endoscopist is in attendance systemic chemotherapy with the *sulfonamides* (p 88) or *penicillin* (p 106) is warranted with aerosolization whether or not bacteriological studies reveal the presence of a susceptible organism

CHRONIC BRONCHITIS

Chronic bronchitis is commonly encountered in persons beyond middle age It is more frequent in the male and develops almost without exception on the basis of some pre existent clinical disorder

CHAPTER 103

THE RESPIRATORY SYSTEM LOBAR PNEUMONIA AND ACUTE PNEUMONITIS

LOBAR PNEUMONIA

LOBAR pneumonia is an acute respiratory infection characterized by an exudative *inflammatory reaction in one or more lobes of the lungs* It is usually but not invariably caused by one of the varieties of the *pneumococcus* (p 199) It may result also from invasion with *hemolytic streptococci* (p 160) *staphylococci* (p 151) *B mucosus capsulatus of Friedlander* (p 328) *tubercle bacillus* (p 252) *B melitensis* (p 314) *P pestis* and *B anthracis* (p 292)

Incidence—In our clinical experience true lobar pneumonia is a *relatively uncommon disease It is our opinion that mass statistical evidence* of its incidence is misleading since so often the diagnosis is made when the patient actually is suffering from one of the *non lobar types of pneumonitis* (p 2185) *next to be described*

Experiences in army camps where medical officers stand much in the same relationship to their personnel as does the practitioner to his private patient *tend to lend support to our opinion Using careful bacteriological* studies and early roentgenograms army officers find that the ratio of lobar pneumonia to non lobar pneumonitis approximates 1 30

It may well be argued that *army figures are not strictly applicable to* civilian practice since they do not include the lobar pneumonias of infancy the debilitated and the aged Making allowances for these variables *however it is fair to conclude that nonlobar pneumonitis is far more frequent* than lobar pneumonia from which it requires careful differentiation (p 2182) with particular reference to prognostic implications and the evaluation of chemotherapeutic agents

Bacteriology.—In the period that followed the introduction of type anti pneumococcus serum and before the introduction of the sulfonamides there was wide interest in bacteriological studies of sputum Not only was the *causative organism* identified but the *determination of type* was necessary before injecting type specific antipneumococcal serum

The miracle of chemotherapy has resulted in an unfortunate apathy towards bacteriological studies of sputum There has been a general inclination to treat the patient and investigate the exact nature of the etiologic agent only in the presence of an unsatisfactory response to the drug As a result chemotherapy is instituted in many respiratory conditions such as *virus pneumonitis* (p 2188) where it accomplishes little of benefit Accurate evaluation of chemotherapy is in fact obscured by lack of adequate bacteriological controls

This viewpoint is not intended to influence the practitioner to withhold the drug in instances where it can be of possible value but to urge bacteriological examinations of the sputum *before therapy is instituted*

Ulceromembranous chronic bronchitis may progress to the formation of *lung abscess* and *gangrene* (p 2214) Systemic chemotherapy with the arsenicals (p 116) penicillin (p 106) or the *sulfonamides* (p 88) alone or in combination may be rewarded by specific cure

Fibrinous Bronchitis —Casts of the bronchi may be coughed up in rare instances of severe chronic bronchitis In earlier medical periods these were often the result of a *diphtheritic infection* (p 302) but they may also have originated in nonspecific infections

Chronic fibrinous bronchitis does not differ from other varieties except that *cough* is more violent and often paroxysmal *dyspnea* is more severe and the sputum contains the characteristic casts

Diagnosis —The practitioner does not rest with the diagnosis of a chronic bronchitis but seeks to discover the more fundamental lesion His survey includes the *sputum examinations* elsewhere described (p 3719), and chest *roentgenography* followed by *bronchography* if ordinary examinations fail to reveal significant changes At the time of bronchography *endoscopic examination* is advisable since the expert may discover by this procedure an intrabronchial lesion amenable to direct therapy The *paranasal sinuses* are investigated antral lavage is performed for diagnostic purposes if nothing more tangible has been disclosed, skin tests are performed for evidences of sensitization to inhalants bacteria tuberculosis, or brucellosis

Treatment —The treatment of chronic bronchitis depends upon the more fundamental etiologic factors Palliative therapy consists of *steaming* the use of *expectorants* and *climatotherapy* (p 3761) for those who can afford transplantation A probatory course of sulfonamide (p 88) and/or penicillin (p 106) may be helpful if it accomplishes nothing more than the elimination of secondary invaders

process in which a certain amount of exudate is coughed up and the rest is borne away by the scavenger macrophages One way or another normal resolution takes eight to fourteen days and is usually followed by complete anatomical and functional restoration to normal in the alveoli, bronchi and pleura.

Clinical Manifestations

The incubation period of lobal pneumonia is difficult to ascertain In a few accidental infections that occurred in laboratory workers it varied from a few hours to two days Most often the onset of a lobar pneumonia is sudden whether or not there has been a preceding upper respiratory infection The chief herald symptoms include the chill rise in temperature pain in the chest and cough

Chill—A chill occurs at the onset in one half to three quarters of all patients with pneumococcal lobar pneumonia It is usually a teeth chattering rigor which may persist for a few minutes to an hour and it may be repeated In older and debilitated individuals with less tempestuous febrile reactions there may be only *chilliness* which is more persistent than the shaking chill (p 31)

Fever—Despite the chilly sensation the rectal temperature quickly approaches 104° to 106° F After the rigor has subsided the face becomes flushed the patient feels uncomfortably hot and rejects the blankets and hot water bottles which but a few minutes before had been urgently requested

The temperature response may be atypical in debilitated patients and alcoholics With minimal pyrexias or normal temperatures the prognosis is most unfavorable

Pain in the Chest—Pleural pain occurs in 75 per cent of the patients It may be dull or sticking often it is sharp and lancinating producing an *expiratory grunt* and causing the patient to rest on the affected side Deep breathing and cough intensify the distress so that the patient resorts to shallow respiration which contributes to dyspnea and cyanosis

Chest pain is probably produced by inflammation of the parietal pleura and is most often referred directly to the area overlying the involved lung Deceptive and confusing references may be experienced Radiation to the abdominal region may simulate a peritoneal irritation from acute cholecystitis (p 2007) or appendicitis (p 1881) and shoulder pain suggests an angina (p 890) an arthritis (p 2934) or a *coronary accident* (p 983)

Tachycardia—The combination of rigor fever and chest pain results in a striking elevation in the pulse rate It is not unusual to observe a minute count that ranges from 120 to 160 with occasional irregularities

Cough—In the initial phases the cough is dry and unproductive Occasionally it is paroxysmal it disturbs rest and aggravates pleural pain

Sputum—It is not until several hours after the onset of a lobar pneumonia that sputum can be obtained During the phase of engorgement it is liquid and serosanguineous but may contain myriads of pneumococci In the stage of red hepatization it becomes rusty or brown in color it is thick and tenacious and contains fewer organisms than in the phase of engorgement

Dyspnea—Rapid shallow breathing is characteristic of lobar pneumonia The minute respiratory rate approximates 25 to 35 but may rise

The advisability of the continuance of chemotherapy may be reconsidered after the bacteriological report has been made

Pathogenesis—Man enjoys a fair degree of *natural resistance* to virulent pneumococci Infection is probably dependent upon more than a mere exposure to the invader and *sus ceptibility* is apparently favored by systemic and local circumstances Among the former are factors such as poverty overcrowding undernutrition chilling exposure to inclement weather and alcoholism The influence of age is apparent from the increased incidence of the disease in infants and the aged

Local provocations include recent attacks of the exanthems and upper respiratory infection meteorological conditions which affect the tracheobronchial secretion and ciliary action occupational trauma due to the effects of irritating fumes gases or gross particles of dust, and chronic pulmonary changes in bronchiectasis bronchial asthma emphysema congestion and fibrosis

The importance of local predisposing factors is well illustrated in experimental pneumonia Lobar involvement cannot be produced by the instillation of pneumococcus cultures into the terminal bronchi unless the organisms are suspended in a starch paste or a mucin suspension which interferes with normal ciliary action and the self cleansing function of the lungs The evolution of the disease probably involves the introduction of pneumococci past the glottic barrier a failure to repel the organisms by ciliary action and the protective influences of bronchial mucus and the onset of lobar inflammation and a resultant, rather than an initial bacteremia

On reaching the alveoli pneumococci stimulate an outpouring of inflammatory exudate consisting of edema fluid leukocytes erythrocytes and alveolar epithelial cells The exudates spread directly to adjacent alveoli and by way of the bronchioles to all or a part of a lobe The explosive nature of the onset of the infection is analogous to a *protein sensiti ation* There is much to suggest that *allergy* may play a significant role in the rapidity with which the pathological process evolves in the affected lobes

Pathology—Lobar pneumonia most often affects the *lower lobes* more frequently the *left* Upper lobe lesions are present alone in but 10 to 15 per cent of instances The initial reaction is an *inflammatory edema* which spreads in wave-like fashion with the oldest lesions at the center and the youngest at the periphery All stages are represented somewhere at any given time

The Stage of Engorgement—The stage of engorgement is characterized by an outpouring of an *inflammatory exudate* which contains pneumococci erythrocytes polymorphonuclear leukocytes and fibrin The alveoli become choked with this material which spreads (1) by way of the *bronchioles* to the remainder of the lobe (2) *hematogenously* producing a bacteremia and (3) by way of the *lymphatics* to the hilar glands and pleural surfaces

Red Hepati ation—Within twenty four to forty-eight hours after onset the pneumonic area appears firm airless and friable the cut surface is dryer than in the phase of engorgement but not as dry as in the stage of gray hepatization The red hepatization is due to an increase in fibrin which is found in threadlike masses within the alveoli capillary engorgement and the presence of great numbers of erythrocytes

Gray Hepati ation—Within the course of the succeeding twenty four to forty ei ht hours the gross and microscopic appearances of the hepatized area undergo striking change The lobe appears relatively bloodless it is firm and heavy and the cut surface is dry and friable Microscopic examination discloses that the alveoli are distended with fibrin and masses of polymorphonuclear leukocytes Relatively few red cells remain in the lumen and the capillaries are collapsed

The capillary ischemia of the gray stage of hepatization results partially from pressure of the alveolar exudate on the alveolar capillary wall but it is also due to the presence of numerous capillary fibrin thrombi which mechanically obstruct blood flow

Resolution—Five to eight days after the onset of a lobar pneumonia the stage of resolution is initiated The leukocytes disintegrate the various elements of the alveolar exudate become less distinct and appear amorphous and large *macrophages* arise from the alveolar walls and septa to appear in exudate and gradually become the predominant cell The macrophage reaction is intimately associated with resolution the scavenger cells remove debris from the alveoli and effect a restoration to normal

The mechanism of resolution is poorly understood It may be a *chemical process* associated with the liberation of enzymes from degenerating leukocytes or it may be a *mechanical*

views correct this erroneous impression and show a less distorted image of the involved area as well as retrocardiac shadows

With increase in the consolidation the density of the shadow is augmented but there is rarely the uniform opacity that is characteristic of pleural fluid During resolution the shadow becomes hazy and uneven eventually it disappears except for residual evidences of pleural thickening or exaggeration of the markings of the interlobar septa

Laboratory Findings

Lobar pneumonia is accompanied by characteristic laboratory findings referable to blood and sputum In the early phases of the disease a *bacteremia* (p 49) is almost invariably demonstrable If the blood cultures remain persistently positive an ominous prognosis and failure of chemotherapy are indicated

The Blood —The hemogram shows a characteristic *leukocytosis* that may reach 30 000 to 40 000 cells with 90 to 95 per cent of polymorpho



Fig 496.—Early lobar pneumonia Note the delineation of the inflammatory process by the interlobar fissure

nuclears The outlook is unfavorable if the white count falls below 10 000 cells or rises above 50 000 Immature band forms and other young cells including *myelocytes* appear in variable numbers toxic *granules* are commonly present in the majority of the leukocytes

The *erythrocyte and thrombocyte counts* are rarely altered unless there are complicating factors *Blood volume* ordinarily is increased as the result of water retention the *globulin* and *fibrinogen fractions* of the plasma proteins are increased the *erythrocyte sedimentation rate* is accelerated *false Wassermann reactions* occasionally are encountered *chloride retention* is frequent but other changes in the chemistry of the blood are neither of diagnostic nor therapeutic importance

Sputum —The practitioner must make a conscientious effort to obtain sputum before initiating chemotherapy Cultures usually reveal the presence of *pneumococci* but *staphylococci hemolytic streptococci* and the

to 50 or 60 The alae nasi dilate accessory respiratory muscles are called into action orthopnea is not present as in cardiac failure and relief is often afforded by pressure on the affected area or adhesive strapping

The *causes* for dyspnea are numerous and complex They include reduction of vital capacity, voluntary and involuntary splinting of the chest as the result of pleural pain compression of the pulmonary tissue by pleural fluid diminution in the surface area of the functioning respiratory tissue pulmonary congestion and edema, neurogenic reflexes from the edematous pulmonary tissue stimulation of the respiratory center by anoxemia and increased concentrations of carbon dioxide

Cyanosis —Cyanosis is best observed in the lips ear lobes finger tips and the nail beds It appears in lobar pneumonia when the blood oxygen saturation is reduced by more than 10 per cent The combination of the pallor of *vasomotor collapse* (p 928) and the blueness of *oxygen unsaturation* produces the ominous *ashen cyanosis* of such evil prognostic significance

Anoxemia —The anoxemia of lobar pneumonia is of the *anoxic type* (p 890) It results from insufficient oxygenation of the blood as it passes through unaerated consolidated or edematous areas of the lung whose alveoli are filled with exudate A contributing factor to the anoxemia is the rapid shallow breathing which results in inefficient and unequal ventilation of the periphery and apices of the lungs Anoxemia results in harassing and significant clinical symptoms including *restlessness palpitation dyspnea sleeplessness dizziness* and *delirium* It contributes also to *intestinal distention* a complication of more than minor prognostic significance

Physical Examination

During the first few hours the diagnosis of lobar pneumonia is made inferentially Examination reveals meager signs at most, in the involved area diminution in respiratory excursion is observed the percussion note is that of *dull tympany* there may be some *suppression of breath sounds*

At the end of twelve to thirty six hours fine *crepitant rales* may be heard at the end of deep inspiration, over a limited area it is not until the second to fourth days that the classical signs of consolidation become audible Dullness to flatness harsh bronchial breathing and increased vocal and tactile fremitus bespeak the gray stage of hepatization these frank manifestations do not appear until the disease has run almost half of its course

The *involution* of the signs occurs in inverse order a friction rub often becomes audible the crepitant rales return breath sounds become diminished before they return to normal

Roentgenography

Roentgenological *evidences of consolidation precede the appearance of* definitive physical signs Within twelve to twenty four hours a *wedge shaped shadow* of hazy density appears at the periphery of the lung and points toward the hilum Postero anterior films may reveal the shadow as a rounded area of density at the hilum (*central pneumonia*) but lateral

ally occurs at the end of one or two weeks although occasionally a patient may survive for several months

Specific therapy with streptomycin (p 103) promises to arrest if not cure tuberculous pneumonia Intramuscular doses of 0 5 gm four times daily for several months are required In our experience promin (p 267) is disappointing and we have no confidence in gold salts (p 2022)

Staphylococcal and Streptococcal Lobar Pneumonia—Staphylococcal and streptococcal lobar pneumonias are unusual They may be encountered following *measles* (p 409) or *scarlet fever* (p 171) or during the course of an *influenza epidemic* (p 396) Each of these invaders is prone to produce complicating *pleural effusion empyema thoracic* (p 2222) and *multiple aputrid pulmonary abscesses* (p 2214)

Course

The course of lobar pneumonia is rarely observed in modern medical practice Unmodified by extraneous influences the sequence of events follows a fairly typical pattern The onset can be estimated almost to the hour by the appearance of *chill fever pain in the chest* or *cough* Under usual circumstances the patient appears acutely and seriously ill the *respiratory* and *pulse rates* rise in proportion to the fever and chest pain the face is flushed *respirations* are shallow and characterized by the expiratory grunt the *alae nasi* dilate with each breath the patient lies upon the affected side coughing is constant and increases the degree of pleuritic pain *cyanosis* often is visible on inspection of lips ear lobes nail beds or finger tips the *mental state* may be depressed or anxious and there may be ceaseless *activity* and *delirium* or *apathy* approaching coma

Uncomplicated Favorable Course.—In uncomplicated examples the illness lasts from four to eight days The temperature curve at first shows slight daily fluctuations but later there are greater variations In perhaps half of the cases the disease terminates by a dramatic *crisis* with rapid fall of temperature and profuse diaphoresis Following the crisis the patient often falls into a deep sleep and awakens with a buoyant sensation of well being Lobar pneumonia in the remaining favorable instances terminates by *lysis* with a fall of temperature to normal over the period of thirty six to forty eight hours

Fatalities—Fatalities in untreated lobar pneumonia approximated 10 per cent before the modern era of chemotherapy The figure reached higher proportions in the aged the debilitated and the alcoholic and was lower than average in otherwise healthy children and adults Death ordinarily occurred from *progressive toxemia* with terminal *pulmonary edema* (p 810) Occasionally there occurred a *sudden exitus* from *peripheral vascular failure* with clinical manifestations that resembled *shock* (p 928) In other instances the fatality resulted from one of the complications

Complications

Before the advent of chemotherapy complications were the rule in a lobar pneumonia The more frequent involvements were cardiovascular digestive tegumentary nervous urinary and respiratory

Cardiovascular Complications—The circulatory system may evidence

Friedlander bacillus may be isolated in pure culture or in great preponderance In the event that antipneumococcus serum may be required *pneumococcus typing* by the Neufield technic (p 201) is essential

The mere isolation of pneumococci in the sputum does not invariably indicate the presence of pneumococcal pneumonia The normal nasopharynx often harbors Types III and VI and the higher' varieties beyond VIII The appearance of Types I II V and VII, however is strongly suggestive of invasion and pathogenicity

Pneumococcus Typing —Information of some value in prognosis is obtained from type determinations *Type I* is responsible for 25 per cent of all pneumococcal lobar pneumonia Before the days of sulfonamide therapy complications particularly empyema occurred in 20 per cent bacteriemia was present in nearly a third of the patients, and the mortality rate among bacteriemic patients was seven or eight times as high as among nonbacteriemics

Type II pneumococcus causes about 10 per cent of all lobar pneumonia bacteriemia occurs in 40 per cent of untreated patients and the case-fatality rate of Type II *infection is higher than that of any other type* with the exception of III

Type III had the highest case fatality rate before the era of chemotherapy It is still the most dangerous type of pneumococcus Its high mortality rate of 40 to 60 per cent in untreated patients was due to its virulence and its predilection for attacking old and debilitated persons

Types IV V VII and VIII produce infections similar in most respects to Types I and II The *higher types* of pneumococci are less invasive and have lower bacteriemic rates than the lower types

B Mucosus Capsulatus—The Friedlander bacillus is responsible for 1 to 2 per cent of lobar pneumonias These invasions are characterized by *severe toxemia upper lobe involvement* is more frequent than in the pneumococcal variety the sputum is often characteristically thick gelatinous and brick red the *radiographic shadow* is denser than the expectancy with pneumococcal involvement *direct smears* of sputum reveal many encapsulated short gram negative bacilli *dyspnea* and *cyanosis* are apt to be extreme *complications* are frequently encountered and include the production of multiple small areas of necrosis and abscess formation

The Friedlander bacillus responds to streptomycin therapy (p 103) *Doses of 2 0 gm daily in four equal amounts are injected intramuscularly* for a period of at least five to seven days Parenteral administration may be supplemented by aerosolization (p 2041)

B Tuberculosis (Galloping Consumption)—The tubercle bacillus is capable of setting up a lobar consolidation This type of reaction occurs more frequently in *adult males* its *onset* is indistinguishable from that of the more common types of lobar pneumonia

Clinical suspicion of the possibility of a tubercular infection arises when the ordinary organisms are not found in the sputum when there is a failure of response to chemotherapy when neither crisis nor lysis are encountered on or about the end of the first week and when acid fast bacilli are demonstrated in carbolfuchsin stains of the sputum

The *course* of a galloping consumption is rarely favorable death usu

include *hematemesis* from an *acute gastritis* or an *ulceration of the stomach*

Acute Dilatation of the Stomach — Acute dilatation of the stomach is a circumstance most greatly to be feared It may appear insidiously and is suspected when the patient exhibits pronounced swelling in the upper abdomen regurgitation of water brash hiccough and the paradoxical *combination of hunger and nausea* Unrelieved a *gastrectasis* may prove fatal suspicion of its possible presence is sufficient reason for introducing a stomach tube (p 1750)

Adynamic Ileus —The most frequent digestive disturbance in lobar pneumonia is *tympanites* due to an adynamic ileus Many factors contribute to this troublesome and obstinate complaint It is our opinion that intestinal distention is favored by overenthusiastic purging and the excessive uses of fruit juices and milk in the dietary routine Less tangible but equally significant provocative mechanisms include toxemia peripheral circulatory failure and the general toxemia that accompany the disease and its complications

Tegumentary Complications —*Herpes febrilis* is seen more frequently in pneumococcal lobar pneumonia than in any other respiratory disease It appears within a day or two of the onset more often the vesicles are on or near the lips but they may be found elsewhere including the genital region

Jaundice (p 1951) is not infrequent in the course of an uncomplicated lobar pneumonia Its cause is not clearly established but it appears to result from impaired liver function (p 1947)

In pneumococcal bacteriemias of infants the aged and the debilitated *multiple subcutaneous abscesses* may be encountered

Neurological Complications —Especially in young children lobar pneumonia is apt to be heralded by evidences of meningeal irritation (*meningismus*) with *convulsions* Restlessness disorientation stupor mania or delirium are common symptoms in the course of untreated disease Alcoholics (p 3851) are prone to develop *acute psychoses* during or following the febrile period The crisis may be accompanied or followed by profound *stupor or great agitation*

Neurologic manifestations are most likely related to the *anoxemia* and they yield to *oxygen therapy* (p 3827) Air hunger may explain the frequency with which patients with lobar pneumonia terminate their lives by leaping from an open window

Urinary Complications —Transitory *albuminuria* accompanies the febrile reaction in pneumococcal pneumonia The microscopic sediment ordinarily reveals a variable number of casts leukocytes and erythrocytes Kidney function however is not seriously impaired and the abnormal urinary constituents disappear rapidly in convalescence Acute glomerulonephritis as a complication of lobar pneumonia is exceedingly rare

Respiratory Complications —The respiratory complications of lobar pneumonia include pleuritis empyema thoracis pulmonary abscess atelectasis spontaneous pneumothorax organization and relapse

Pleuritis —Acute pleuritis is more a part of lobar pneumonia than a complication It accounts for the early *chest pain* (p 2173) and is usually associated later with a small *pleural effusion* (p 2219) The fluid usually is sterile and ordinarily absorbs spontaneously during convalescence

functional or organic complications in the course of a lobar pneumonia The less frequent but more ominous organic cardiovascular complications include *endocarditis* (p 1020) resulting from persistent bacteriemia, and *pericarditis* (p 1007) which usually occurs as an extension of the pleuritis

Peripheral Circulatory Failure—Functional cardiovascular complications are encountered with greater frequency Older clinicians noted the evil prognostic significance of a minute pulse rate in excess of the systolic blood pressure in millimeters of mercury While the clinical axiom is not necessarily absolute there is no denial of the fact that an increasing pulse rate with a falling blood pressure suggests the onset of peripheral circulatory failure (p 000) In this exigency the experienced practitioner notes that the patient *looks sick* the color is that of an *ashen cyanosis* the extremities are cold the temperature and blood pressure readings tend to fall while the pulse and respiratory rates rise dyspnea is more urgent there is a feeling of tenseness and anxiety with a sense of impending dissolution tympanites increases the sensorium becomes increasingly *dulled* or is activated into a panic state with restlessness mania and delirium

Cardiac Irregularities—Irregularities in cardiac rhythm are detected in 10 to 20 per cent of untreated patients The majority of disturbances are *auricular or ventricular premature contractions* (p 887) that are of no particular consequence *Auricular fibrillation or flutter* (p 883) occurs in perhaps 3 per cent of untreated instances of lobar pneumonia major irregularities are more common in those beyond the age of forty *Conduction disturbances* detected only by electrocardiography are present in a small number of cases

It is important to stress again that *digitalis* (p 854) neither prevents nor alleviates cardiac irregularities or peripheral circulatory failure In point of fact there is considerable laboratory and clinical experience to indicate that *functional conditions are more apt to be intensified* than ameliorated by the well intended administration of the drug The preparation of choice for control of the cardiac irregularities is *quinidine sulfate* (p 861) used in 5 to 10 grain doses every three or four hours until sinus rhythm has been restored There is no specific for peripheral circulatory failure, whose management is discussed elsewhere in greater detail (p 945) although injections of *adrenal cortical extract* (p 1267) merit a thorough trial

Digestive Complications—As with the circulatory complications the digestive disturbances that accompany lobar pneumonia are mostly functional An exception is *pneumococcal peritonitis* (p 1029) which is most common in infancy the aged and debilitated Its presence is often unrecognized since the characteristics may be those of a soft belly peritonitis (p 1027) with absence of pain rigidity or striking constitutional change The attention of the clinician is drawn to the abdomen by obstinate constipation persistent distention a progressively unfavorable clinical course and eventual signs of fluid in the cavity

The *functional disturbances* of the digestive system include anorexia vomiting acute dilatation of the stomach and adynamic ileus

Anorexia—Anorexia is almost invariable in the patient whose temperature exceeds 103° F *Vomiting* is infrequent and most often results from drug therapy with the coal tars or the sulfonamides Rare complications

in old and debilitated patients and in alcoholics Under any of these circumstances each and even all of the cardinal features may be lacking true shaking chills are unusual the febrile elevation may be mild to moderate there may be neither leukocytosis nor chest pain cough and sputum are lacking The first indication of the true nature of the pathological process may be the notation of frank signs of consolidation which finally appear after repeated meticulous examinations

The presence of a lobar pneumonia may escape notice when the *pleural pain* is referred above or below the area of the thorax In the former instance *shoulder pain* radiating down the left arm suggests the presence of an *angina pectoris* (p 890) or a *coronary closure* (p 983) The former condition is not associated with fever and leukocytosis the latter is more apt to be accompanied by circulatory collapse tachycardia and fall in blood pressure

Radiation of pleuritic pain to the abdomen gives rise to many serious diagnostic dilemmas particularly when the subjective complaint is associated with *abdominal rigidity* Right upper abdominal pain suggests an *acute cholecystitis* (p 2009) right lower abdominal pain an *acute appendicitis* (p 1881) left upper abdominal pain simulates a *splenic infarct* (p 1130) the *anginal syndrome* (p 890) or a *coronary closure* (p 983) epigastric pain arouses the suspicion of a penetration or perforation of a *peptic ulcer* (p 1780) Most of these conditions may be associated with fever and leukocytosis most require institutionalization often for purposes of *exploratory laparotomy* Under the latter circumstance the practitioner is wise if he insists in an instance of reasonable doubt upon preoperative chest *roentgenograms* since the appearance of the pneumonic shadow may antedate physical signs by many hours or even days

Errors of Commission —In our experience the diagnosis of lobar pneumonia is too often made when the condition does not exist The most common error is the inclusion of *acute pneumonitis* next to be described (p 2185) in the category of lobar consolidations This error is of more than academic significance since pneumococcal lobar pneumonia responds almost specifically to chemotherapy whereas the various types of nonlobar pneumonitis are less often affected favorably by these same agencies

The important clinical features in differential diagnosis are summarized in Table 131

At times it is necessary to distinguish between lobar pneumonia and other intrathoracic conditions such as *pleurisy* (p 2219) *massive atelectasis* (p 2053) and *pulmonary infarction* (p 2086) The first of these becomes clearly apparent in the presence of the characteristic *friction rub* with massive atelectasis there is *cardiac displacement* toward the side of the lesion pulmonary infarction almost invariably stems from a demonstrable *thrombophlebitis* of the extremity veins (p 1124) and is often accompanied by the expectoration of bright red sputum

Prognosis

The figures that have been previously given for the prognosis of pneumococcal lobar pneumonia require complete revision in the light of present experiences with anti infective therapy It was not unusual in pre sulfonamide days to be compelled to admit to a case fatality rate of 30 to

See *Pleurisy* (p 2220)

Empyema—Empyema thoracis is a serious aftermath of lobar pneumonia In the era which preceded chemotherapy the incidence of empyema approximated 10 per cent The complication ordinarily is encountered first at the time that the acute symptoms of the pneumonia are subsiding (*parapneumonic*) often it is *postpneumonic* making its initial appearance several days after crisis or lysis has been accomplished

See *Empyema Thoracis* (p 2222)

Aputrid Lung Abscess—Aputrid pulmonary abscess (p 2214) occurs as a complication of pneumococcus pneumonia in only 3 per cent of untreated patients It appears most often as the result of Type III pneumococcal or *B mucosus capsulatus* involvements and usually consist of multiple small excavations which are visible only on roentgenograms

See *Abscess of the Lung* (p 2214)

Atelectasis—Massive atelectasis caused by the plugging of a bronchus is of occasional occurrence in the course of a lobar pneumonia The symptoms and signs are elsewhere described (p 2052) *therapy* is accomplished best by mechanical measures and inhalations of 5 to 10 per cent carbon dioxide and oxygen (p 3827)

Pneumothorax—Spontaneous pneumothorax is rarely encountered in the course of a lobar pneumonia It probably results from the rupture of a cyst and produces severe distress with characteristic physical signs (p 3956) Urgent symptoms may require release of tension by aspiration

Unresolved Pneumonia (*Organization*)—So called unresolved pneumonia is probably nonexistent Most likely the persistence of physical signs or symptoms (organization) results from local complications such as pulmonary abscess (p 2214) bronchiectasis (p 2059) empyema thoracis (p 2222) or encapsulated pleural effusion

Relapse—Relapse in the course of lobar pneumonia is rare if it occurs at all *Spread of infection* to other lobes indicates a continuation of the invasiveness of the etiologic organism *Reinfection or superinfection* with pneumococci of other types or another organism such as the staphylococcus or hemolytic streptococcus occurs occasionally and is revealed by sputum examination

Diagnosis

When lobar pneumonia presents its typical characteristics the diagnosis offers little difficulty even in the absence of clearly demonstrable physical signs of consolidation The history of sudden onset with chill fever chest pain and sputum can leave little doubt in the practitioner s mind as to the presence of lobar involvement most likely with the pneumococcus The suspicion is confirmed in the presence of herpes and a leukocytosis but a definitive opinion requires x ray and sputum examination The former reveals the wedge shaped shadow at a time when physical signs are meager the latter taken before sulfonamide therapy has been instituted discloses the invading micro organism

Errors of Omission—The diagnosis of acute lobar pneumonia may be missed when the constitutional features are masked by the enfeebled condition of the patient or when the pleural pain is atypical

Lobar pneumonia may be difficult of recognition in the very young

in old and debilitated patients and in alcoholics Under any of these cir cumstances each and even all of the cardinal features may be lacking true shaking chills are unusual the febrile elevation may be mild to mod erate there may be neither *leukocytosis nor chest pain cough and spu tum* are lacking The first indication of the true nature of the patholog ical process may be the notation of frank signs of consolidation which finally appear after repeated meticulous examinations

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The figures that have been previously given for the prognosis of pneu mococcal lobar pneumonia require complete revision in the light of present experiences with anti infective therapy It was not unusual in pre sulfo namide days to be compelled to admit to a case fatality rate of 30 to

40 per cent in institutional experience The mortality was higher in infants and the aged in the debilitated and alcoholics With persistent bacteriemia a fatal outcome impended other ominous forebodings included hyperpyrexia an inadequate febrile reaction hyperleukocytosis leukopenia tachycardia out of proportion to the febrile elevation dyspnea out of proportion to the febrile elevation *evidences of peripheral circulatory failure*, the onset of complications the development of ileus or gastrectasis the appearance of delirium or coma and a progressive lowering of blood pressure

Specific chemotherapy has changed the prognostic picture in lobar pneumonia The demonstration of lobar consolidation and pneumococci in the sputum holds promise of favorable response to anti infective agents Absence of specific improvement within forty eight to seventy two hours suggests some unusual circumstance such as insufficient dose initial bacteriemia an infection with a *resistant strain* of pneumococcus or invasion

TABLE 131 —DIFFERENTIAL DIAGNOSIS OF LOBAR PNEUMONIA AND ACUTE PNEUMONITIS

	Lobar Pneumonia	Acute Pneumonitis
Onset	Acute	Gradual
Chills	Frequent	Rare
Initial Temperature	Exceeds 103 F	Less than 103 F
Initial Chest Pain	Severe	Mild or absent
Herpes	Frequent	Rare
Leukocyte	Elevated	Usually normal
Roentgenograms	Wedge-shaped shadow	Scattered infiltrations
Sputum	Laden with pneumococci	Mixed flora
Response to sulfonamide or penicillin	Consistently favorable	Less often favorable

with *B mucosus capsulatus* On rare occasions the lack of response may be due to a lobar inflammation caused by the *tubercle bacillus* as revealed in carbolfuchsin stains of the sputum

Treatment

The treatment of lobar pneumonia requires supportive therapy the institution of specific chemotherapeutic and immunological measures

Supportive Therapy —The patient with lobar pneumonia is *institutionalized* if it is at all possible Complete *bed rest* is required constant *nursing observation* is necessary to prevent untoward accidents which are apt to occur in the *early stages* when chilling and hyperpyrexia are accompanied *by neurological disturbances and later following* the crisis

Bed pan and *urinal* are utilized *Steam inhalations* (p 2028) tend to fluidify the sputum and relieve the strain of coughing The application of a tight *chest binder* adds immeasurably to comfort and does not interfere with physical examination as does adhesive strapping The latter is par

ticularly apt to cause maceration of the skin in the presence of steamings and diaphoresis

Hyperpyrexia is best controlled by *sponging* The *ventilation* of the sickroom is regulated according to the comfort of the patient There must not be excessive cold at the behest of fresh air fiends the room should not be kept at incubator temperature through fear of draughts

The Digestive System and Bowels—Because of the short duration of the illness no attention need be paid to the *caloric intake* nor the balancing of the diet The patient is urged to drink *fluids* liberally and take as much nutrition as is compatible with comfort *Nurses are warned against overzealousness in forcing fluids and nourishment* fruit juices carbonated drinks and the use of excessive amounts of milk are avoided since these tend to encourage the development of *tympanites* (p 1878) *Vitamin supplementation* is not required and there is no necessity to ply the victim with enormous quantities of *salt*

We oppose *initial purging* which tends to dehydrate and tire the patient and predispose to the later production of an adynamic ileus (p 1857) The bowels are best regulated by a daily *enema* Distention is prevented by the avoidance of initial purging and the tempered use of fruit juices carbonated drinks and milk At the slightest tendency to ileus prophylactic intramuscular injections of 1 4000 *prostigmine* (p 3874) are inaugurated with repetition at four to six hour intervals using doses of 1 to 2 cc depending upon the patient s response

Nonspecific Medication—We oppose *overmedication* in the treatment of lobar pneumonia That principle requires reemphasis in the present era of chemotherapy when it is of great importance to avoid the administration of any substance that might interfere with the specifics

We favor the initial injection of *dilaudid* 2 mg (grains $\frac{1}{30}$) with or without *hyoscine hydrobromide* 0.5 mg (grains $\frac{1}{120}$) to allay anxiety restlessness chest pain and cough We avoid the diurnal use of cough mixtures and cough sedatives containing opiates particularly codeine and save the *dilaudid hyoscine* combination for a night cap with repetition during the early hours of the morning if necessary During the other hours of the day reliance is placed upon *steamings* and the expectorant action of *Liquor Ammoniae Anisatus* in 30 drop doses given every two hours in $\frac{1}{4}$ to $\frac{1}{2}$ glass of warm water

Our only other preference for nonspecific drug action during the course of a lobar pneumonia is relative to *prostigmine* in the prevention and treatment of intestinal distention as previously noted (p 2183)

Drugs to be Avoided—It is our experience that the patient with lobar pneumonia is often overmedicated to his own disadvantage *Purges* lead to later distention sufficient *cough sedative* to relieve the respiratory symptoms is enough to result in meteorism many *expectorants* produce anorexia or nausea the *antipyretic drugs* may give rise to nausea and vomiting and interfere with the administration of the sulfonamides

Those drugs which we avoid unless there is some very urgent and specific indication are *cathartics antipyretics cough mixtures* oral preparations of the *opiates digitalis vitamin preparations sedatives* so called *respiratory and circulatory stimulants* to include *epinephrine coramine camphor metrazol caffeine strychnine lobeline* and the like

40 per cent in institutional experience The mortality was higher in infants and the aged in the debilitated and alcoholics With persistent bacteriemia a fatal outcome impended other ominous forebodings included hyperpyrexia, an inadequate febrile reaction, hyperleukocytosis leukopenia tachycardia out of proportion to the febrile elevation dyspnea out of proportion to the febrile elevation, evidences of peripheral circulatory failure, the onset of complications, the development of ileus or gastrectasis the appearance of delirium or coma and a progressive lowering of blood pressure

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pneumococcal infection Despite the efficacy of immunotherapy the method is cumbersome and technically difficult compared to treatment with sulfonamide or penicillin It is necessary to obtain good sputum the organism must be isolated a typing is required before the specific serum is chosen tests for sensitivity are required whether horse or rabbit sera are employed the intravenous injection must be given slowly and in dilution if reactions are to be avoided and none of the serums is sufficiently polyvalent to give the blanket coverage of sulfonamide or penicillin

Other Specifics —The successes of sulfonamide specific antipneumococcal serum and the antibiotics have relegated to limbo other allegedly specific antipneumococcal remedies The forgotten cures include *diathermy* (p 3788) *roentgen therapy* (p 3796) the production of *artificial pneumothorax* (p 2033) and the use of *hydroxyethylapocupreine dihydrochloride* a derivative of *ethyl hydrocupreine* (*optochin*) (p 204)

Discharge Visit —It is our practice to insist upon an office visit after recovery from pneumonia and before resumption of activities Roentgenography of the chest is required the upper respiratory passages are scrutinized for evidences of factors provocative of recurrences and the intrathoracic structures are reviewed for any semblance of chronic change

ACUTE PNEUMONITIS

The term acute pneumonitis is intended to provide blanket coverage for the *nonlobar types* of inflammation involving the pulmonary alveoli It includes the entities of *bronchopneumonia interstitial pneumonia atypical pneumonitis virus pneumonia influenzal pneumonia grippal pneumonia postoperative pneumonia migratory pneumonia* and the like

The varied etiology of acute pneumonitis requires that the diagnosis be qualified by reference to the *causative organism i e* acute pneumonitis due to influenza virus streptococcus haemolyticus pneumococcus Type III etc Only in this way is it possible to predicate the course offer an intelligent prognosis and conduct adequate specific therapy

Incidence —Acute pneumonitis is one of the commonest conditions with which the practitioner is confronted It frequently accompanies the common *upper respiratory infection* (p 2105) and appears as a *terminal* or *complicating condition* in infancy and old age and in such conditions as debilitating disease circulatory failure recent acute infection and alcoholism Compared to lobar pneumonia (p 2171) acute pneumonitis is seen in army camps in a ratio that approximates 30 to 1 our experiences in private practice indicate a very similar preponderance

Etiology —Almost any bacterial organism is capable of producing a pneumonitis The more commonly encountered invaders include *unidentified viruses* the *influenza virus hemolytic streptococci* hemolytic *Staphylococcus aureus pneumococci H influenzae* and *H pertussis* The less frequently encountered etiologic agents are *E typhosus M tuberculosis B anthracis* (woolsorter s disease) *B melitensis P pestis P tularensis B mucosus capsulatus* the *fusospirochetes* the *rickettsia* of *typhus Rocky Mountain Spotted and Q Fevers* the viruses of *measles psittacosis ornithosis* and *lymphocytic choriomeningitis* the *mycotic group* of organisms particularly the *coccidioidomycosis* (San Joaquin or Desert

Oxygen Therapy—Despite the beneficences of specific therapy, lobar pneumonia is still a formidable infection in infants the aged the debilitated and the alcoholic In these instances supplementary palliative therapy is often required and the manifestation which demands relief most frequently is *anoxemia*

Indications—Indications for oxygen therapy are the presence of more than slight *cyanosis increasing dyspnea* a *respiratory rate* of 36 or more *restlessness* intractable *cough* and *insomnia*

Oxygen may be administered in an oxygen room or chamber in an oxygen tent by nasal catheter or face mask To overcome cyanosis the oxygen concentration of the inspired air must be at least 30 per cent With the nasal catheter or metal inhaler, a flow of 4 liters per minute is generally satisfactory in the tent a rate of 6 liters per minute produces a concentration of 40 to 60 per cent Face masks deliver any desired concentration of oxygen they are inexpensive convenient easy to operate and readily available

Anti infective Therapy—Specific therapy for pneumococcus pneumonia accomplishes results that are so remarkable that little else need be done in order to assure recovery of the patient The oral drug of choice is *sulfadiazine* of which 3 to 6 gm may be given as the initial dose with 1 gm every four hours thereafter until conditions are completely controlled Only in rare instances is it necessary to administer the drug parenterally under those circumstances *sodium sulfadiazine* or *sodium sulfathiazole* may be given intravenously in 1 per cent solution until 5 0 gm (75 grains) are delivered (500 cc)

The practitioner does not lose sight of the fact that the sulfonamide drugs have *potential danger* and he observes his patient carefully for evidences of untoward manifestations the *urine* is examined at frequent intervals for the presence of erythrocytes or crystals *blood counts* are made frequently to assure against the production of a blood dyscrasia

The effects of specific chemotherapy are spectacular In the majority of patients the temperature falls below 100° F within twelve to forty eight hours pulse and respiratory rates return to normal somewhat more slowly If treatment is begun more than forty eight hours after onset the pulmonary lesion progresses to the stage of consolidation and then resolves in the same manner as an untreated example of lobar pneumonia If treatment is begun at an earlier stage it may be possible to abort the pathologic process and frank signs of consolidation may never develop at all Complications are encountered with great rarity failures are few and far between

Penicillin—The specific treatment of pneumococcal pneumonia already surfeited with riches has most recently been enhanced by the introduction of the antibiotics particularly *penicillin* (p 106) This amazing substance is easy to administer and produces an accomplishment that exceeds that of sulfonamide without risk of untoward reaction Intramuscular injections at three or four hour intervals of 25 000 to 50 000 Oxford units are all that are required Penicillin may be used in combination with oral sulfonamide

Antipneumococcus Serum—Type specific antipneumococcal *horse and rabbit serums* are available for the treatment of the common types of

The more common varieties as observed in clinical practice include the descending respiratory infection endemic or epidemic virus pneumonitis and influenza the typhopneumonias tuberculous bronchopneumonia postoperative pneumonitis acute exacerbations of chronic pulmonary infection and the hypostatic pneumonia that often initiates the last act in the debilitated and those who suffer from chronic disease

The Descending Respiratory Infection —The occurrence of an acute pneumonitis in the course of an upper respiratory infection (p 2105) is most often unsuspected The patient appears somewhat more ill the course is somewhat more prolonged and severe the *temperature* rises a little higher

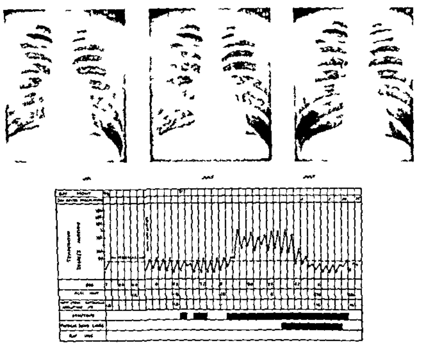


Fig 497—Showing evolution of an experimental case of primary atypical pneumonia After 2 intermittent periods of respiratory symptoms the patient became ill with moderately severe atypical pneumonia on the twelfth day post inoculation Remittent fever persisted for ten days Patchy pneumonic infiltration of the entire right lung and left lower lobe were demonstrable in roentgenograms *

prostration and *headache* are intensified the *cough* is more annoying and the amount of *sputum* is increased there may be some *pain in the chest* and a slight increase in the *rate of respiration* Ordinarily the *blood count* is not altered *sputum examination* reveals the usual nasopharyngeal flora a predominating strain is not observed unless there is a secondary infection with a streptococcus a staphylococcus or a pneumococcus the *hemogram* reveals no abnormality as a general rule *roentgenograms* however show a surprisingly large proportion of patchy infiltrations in areas over which physical signs cannot be elicited

The *course* of this type of pneumonitis is rarely prolonged *complica*

* Dingle Bull of N Y Acad of Med May 1945

Fever) *actinomycosis torulosis moniliasis aspergillosis* and other as yet unidentified micro organisms and viruses

Pathogenesis—Whereas pneumococcal lobar pneumonia attacks healthy adults in apparently excellent physical condition the various types of pneumonitis are more apt to occur in those who have had a *diminution in local or systemic resistance* or who have been attacked by a particularly *virulent organism* It is the presence of these accessory factors that augments the therapeutic difficulties and darkens the prognosis

Diminished Local Resistance—Acute pneumonitis is most frequent in those who have had a precedent severe or protracted *acute upper respiratory infection* it is common in those who suffer from *chronic respiratory disturbances* such as *the allergic phenomena emphysema bronchiectasis chronic bronchitis pulmonary tuberculosis* and the various types of *pneumoconiosis* it afflicts workers in industries that involve exposure to *irritant fumes and chemicals* and as an aftermath of *gassing*

Diminished Systemic Resistance—Acute pneumonitis thrives in those whose general systemic resistance is low It is common in *infancy* in the *aged* in those who suffer from *chronic disease* with *cardiac renal* or *hepatic insufficiency* in children who have had a recent *measles scarlet fever pertussis* or *varicella* It is particularly prone to occur in the wake of *an epidemic of grippe or influen a* when secondary invaders *such as hemolytic streptococcus* and hemolytic staphylococcus aureus attack the already damaged respiratory epithelium

Exposure to Virulent Organisms—A particularly invasive organism is capable of producing acute pneumonitis in otherwise healthy individuals Such is the case in *virus pneumonitis* in epidemics of *influenza* in *pertussis tuberculosis typhoid fever "woolsorter's disease brucellosis plague tularemia rickettsial disease psittacosis ornithosis lymphocytic choriomeningitis coccidioidomycosis actinomycosis* and other mycotic invasions

Epidemiology—The epidemiologic features of acute pneumonitis are difficult of elucidation Certainly the disease seems more common in the *spring* and *fall* Small *epidemics* and worldwide *pandemics* are especially prone to occur with the *influen a virus* (p 396) More recently attention has been directed to the entity of *virus pneumonitis* (p 2188) which bears a close relationship to the *common cold* (p 391) *grippe* and *influenza* (p 396)

Acute pneumonitis of endogenous origin is necessarily sporadic isolated examples are encountered in those with diminution of local or *systemic* resistance

Pathology—The pathology of acute pneumonitis is a variable The infection may descend the bronchial tree and involve the terminal bronchi the alveoli and their septa There may be resultant patchy diffuse pneumonitis In severe instances coalescence of individual lesions may produce a grossly consolidated and apparently lobar pneumonitis The initial microscopic appearance usually is that of edema and blood staining within the alveolar lumen later there may be infiltrations of polymorphonuclear leukocytes and demonstrable bacteria whose presence may be primary or secondary

Complications—More severe pathological involvements are encountered in epidemic influenza staphylococcal invasions brucellosis tuberculosis measles whooping cough plague and anthrax The organisms may cause actual destruction of tissue with secondary *necrosis* and *abscess formation*

In the *necrotizing* types of inflammation there may be eventual formation of multiple *aputrid abscesses* (p 2214) These may coalesce to form one large abscess and spontaneously discharge to heal by fibrosis they may rupture through the pleura and produce an *empyema thoracis* (p 2222)

The more chronic and insidious morphological changes often are not noted until long after recovery With destruction of the bronchial walls septa or alveoli the patient turns up years later with a seemingly idiopathic *emphysema chronic bronchitis* or *bronchiectasis*

Clinical Manifestations

The clinical manifestations of acute pneumonitis are irregular insidious and highly deceptive Unlike lobar pneumonia the disease does not announce itself with striking phenomena such as an acute chill a sudden rise of temperature a sharp pain in the chest or the sudden onset of an irritating cough It insinuates itself in such manner that it is often unrecognized alike by patient and practitioner

The more common varieties as observed in clinical practice include the descending respiratory infection endemic or epidemic virus pneumonitis and influenza the typhopneumonias tuberculous bronchopneumonia postoperative pneumonitis acute exacerbations of chronic pulmonary infection and the hypostatic pneumonia that often initiates the last act in the debilitated and those who suffer from chronic disease

The Descending Respiratory Infection—The occurrence of an acute pneumonitis in the course of an upper respiratory infection (p 2105) is most often unsuspected The patient appears somewhat more ill the course is somewhat more prolonged and severe the *temperature* rises a little higher

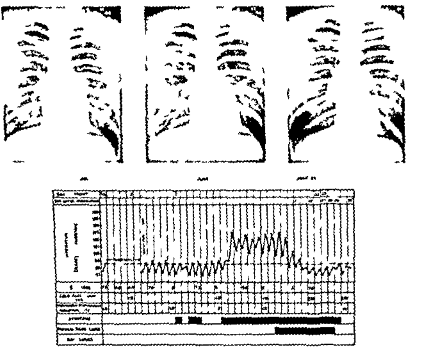


Fig 497—Showing evolution of an experimental case of primary atypical pneumonia After 2 intermittent periods of respiratory symptoms the patient became ill with moderately severe atypical pneumonia on the twelfth day post inoculation Remittent fe e persisted for ten days Patchy pneumonic infiltration of the entire right lung and left lower lobe were demonstrable in roentgenograms *

prostration and *headache* are intensified the *cough* is more annoying and the amount of *sputum* is increased there may be some *pain in the chest* and a slight increase in the *rate of respiration* Ordinarily the *blood count* is not altered *sputum examination* reveals the usual nasopharyngeal flora a predominating strain is not observed unless there is a secondary infection with a streptococcus a staphylococcus or a pneumococcus the *hemogram* reveals no abnormality as a general rule *roentgenograms* however show a surprisingly large proportion of patchy infiltrations in areas over which physical signs cannot be elicited

The *course* of this type of pneumonitis is rarely prolonged *complica*

* Dingle Bull of N Y Acad. of Med May 1945

tions are rare and recovery is the rule Probatory *penicillin therapy* merits trial if the infection is severe or protracted (p 106)

Virus Pneumonitis—The syndrome of virus pneumonitis may be recognized as an entity distinct from other varieties of acute pneumonitis The disease *occurs in* endemic and epidemic form and is apparently due to a specific *organism* as yet unidentified The etiologic agent is undoubtedly a virus which is capable of producing the disease in cotton rats and in human volunteers when sputum obtained from afflicted patients is inoculated *intranasally* The virus apparently is distinct from the agencies which *produce* psittacosis ornithosis and lymphopathia venereum

Virus pneumonitis occurs much more commonly than the other forms of pneumonitis and much more often than lobar pneumonia Van Ravenswaay (J A M A 124 1-6 (Jan 1) 1944) reports the incidence of *1862* infections against 62 of lobar pneumonia in an army encampment The disease is apparently airborne with an incubation period of two to *twenty one days* The onset is gradual in two thirds of the patients and acute in the remainder

Acute virus pneumonitis is introduced by constitutional symptoms *including* fever malaise chilliness, headache and occasionally a frank chill The local symptoms include cough sputum sore throat and chest pain Clinical examination reveals few significant findings there are rarely any changes in percussion or palpation but transitory showers of rales may be heard in approximately half at one time or another

Laboratory data reveal little of positive value The leukocyte count *is normal* blood cultures are sterile and sputum examinations reveal a mixed flora usually of a saprophytic mouth organism The sedimentation time is increased roentgen findings are often absent though sooner or later they reveal scattered areas of infiltration that are far more extensive than anticipated by physical findings

The course of the disease is a variable Many patients are ambulatory throughout their illness and the roentgenologic evidences of the pneumonitis come as a complete surprise Others may pursue a febrile course for as long as six weeks to three months The mortality is 0 26 per cent Recurrences are frequently encountered The rare complications include bronchiectasis ulcerative tracheobronchitis empyema and pleural effusions

The treatment of virus pneumonitis is wholly unsatisfactory Only palliative measures provide any relief since there are no specific therapeutic responses to the administration of adequate doses of the sulfonamides or penicillin Convalescent serum has been reported of occasional value in the patient who is seriously ill and is worthy of consideration particularly in an epidemic when material may be more easily obtained

Because of the wide variation in the course of the disease the efficacy of therapeutic measures is difficult of evaluation For purposes of comparison however the experiences of the United States Army reveal that the average duration of fever is five days and the average period of hospitalization just short of one month Recurrences may be anticipated in one out of every five patients whether or not specific therapy was used and bed rest is continued

Influenzal Pneumonitis—Epidemics and endemics of influenzal or grippal pneumonia occur almost annually At times infectivity and fatality

rates are increased as in the worldwide pandemic of 1918–1919 under usual circumstances influenzal and grippal pneumonitis resemble virus pneumonitis and the descending infection that follows the common cold

Mild Endemic Form—In the milder influenzal episodes *sputum* examinations reveal no preponderant organism *blood counts* are normal the *course* is uncomplicated *specific therapy* yields little of value *recovery* is the rule *fatality* is exceptional unless the affliction is superimposed upon debilitating or chronic disease

Severe Epidemic Form—For reasons that are presently unknown influenzal pneumonia may seriously menace the population of the entire world as in 1918–1919 At that time few escaped infection the *onset* was violent with the early development of *cyanosis* *pulmonary edema* and *extensive pulmonary infiltrations* The *case fatality rate* was high responses to therapy were poor losses in the armed forces exceeded those caused by combat

Typhopneumonia —Certain attacks of acute pneumonitis are preceded by a period of vague distress with fever but lacking respiratory symptoms This clinical picture is observed in *typhoid pneumonia* (p 225) *psittacosis* (p 474) *ornithosis* (p 475) *tuberculosis* (p 252) *tularemia* (p 323) *brucellosis* (p 314) and *coccidioidomycosis* (p 499) Many of these manifestations of pneumonitis are protracted and are complicated by necrotization (p 2209)

Postoperative Pneumonitis—Areas of acute pneumonitis often follow operation whether under local or general anesthesia In all likelihood the *factors of diminished local resistance assume considerable importance* in many instances the invading organism is of endogenous origin being a normal inhabitant of the nasopharyngeal tract

Postoperative pneumonitis may have an insidious or sudden *onset* The patient may complain of *chest pain* *cough* and *expectoration* without subjective manifestations the practitioner may observe rises in temperature and pulse rates with localized signs at one or other base

Postoperative pneumonitis requires differentiation from embolization (p 2066) and the onset of *putrid lung abscess* (p 2215) In embolization there is often but not invariably a *thrombophlebitis* of an extremity vein *the onset is more sudden with expectoration* of *bright red sputum* The early stages of putrid lung abscess (p 2215) are difficult of differentiation from postoperative pneumonitis The most important clarifying circumstance is the presence of a *foul odor* to the breath or the expectoration of *putrid* material

Acute Tuberculous Bronchopneumonia (Galloping Consumption)—In the male adult acute tuberculous pneumonitis may take the form of a lobar consolidation (p 2171) In children when it is usually *associated with* caseation in the bronchial lymph nodes galloping consumption is more apt to be bronchopneumonic

The *clinical manifestations* of *acute tuberculous pneumonitis* are as indefinite as the more commonly observed viral or coccal forms In rare instances the disease is initiated by a *hemoptysis* (p 2058) there may be repeated *chills* the *pulse rate is usually* rapid out of proportion to the elevation of temperature loss of weight and strength occur with undue rapidity

The presence of a bronchopneumonic galloping consumption is often not suspected until an explanation is sought for the failure of deferves cence and the unduly rapid tempo of the cachexia *Sputum examination* then reveals large numbers of acid fast bacilli and an abundance of elastic tissue

The majority of children with 'galloping consumption die within a few weeks of onset particularly if the tubercular infection has followed a *measles* (p 409) or a *pertussis* (p 278) In the remainder recovery sets in at the end of six or eight weeks with considerable permanent damage

Streptomycin (p 103) affords promise of arrest of the infection Doses of 0 5 gm are injected intramuscularly four to six times daily for sev eral months Our experiences with promin (p 267) and gold salts (p 2922) were disappointing

Valley Fever Desert Fever San Joaquin Valley Fever—See Coccidioidomycosis (p 499)

Woolsorter s Disease —The inhalation of anthrax bacilli or spores may give rise to a highly fatal form of pneumonitis The disturbance is largely an occupational disease among those who handle raw wool and breathe in excessive amounts of wool dust

The more common cutaneous form of anthrax is elsewhere described (p 292) In its pulmonary form the disease assumes the nature of an intense necrotizing pneumonitis The onset is abrupt with high fever and chills sputum is thin and bloody The physical signs are those of a dif fuse bronchitis with patchy areas of suppressed or bronchovesicular breath ing The diagnosis is made by bacteriological cultures after suspicion of the nature of the organism from the occupation of the patient

The condition is best treated concurrently with sulfonamide and penicillin An anti anthrax serum should be administered simultaneously

H Influenzae Pneumonitis—On rare occasions the *H influenzae* is isolated in almost pure form from an epidemic of grippe Whether the bacillary form is a primary or secondary invader is debatable but the micro organ ism is definitely capable of producing a *meningitis* (p 286) and an *endo carditis* (p 1021)

Streptococcal Pneumonitis—Hemolytic streptococci may produce acute pneumonitis The invasiveness of the organism is suspected when the up per respiratory lesion is demonstrably streptococcal as in *follicular tonsil litis* (p 2154) or when the pneumonitis accompanies a systemic strepto coccal invasion such as *scarlet fever* (p 171) or *erysipelas* (p 167)

Streptococcal pneumonitis is apt to be accompanied by a *leukocytosis* and may respond specifically to the systemic use of *sulfonamide* or *penicil lin* or a combination of both

Staphylococcal Pneumonitis—Hemolytic staphylococci may produce acute pneumonitis in the wake of an influenza epidemic The organisms are present in almost pure culture in the sputum There is an associated *leukocytosis Necrotization* with the formation of *multiple aputrid ab scesses* is to be anticipated unless specific chemotherapy is instituted early with *sulfonamide* (p 88) and *penicillin* (p 106) either alone or in combination

Staphylococcal pneumonitis is clearly to be differentiated from the

hematogenous *pulmonary furunculosis* (p 2212) *that follows staphylococcemia*



Fig 498—Extensive bilateral bronchopneumonia more marked on the right side *A* Before treatment *B* After penicillin therapy

Pneumococcal Pneumonitis—Secondary pneumonitis is particularly apt to occur as the result of the invasion of the respiratory tract of a debili

Nichols and Harrell, Medical Clinics of North America, July 1944

tated individual by pneumococci of Type III and those beyond VIII The organisms are demonstrable in the sputum in pure culture, bacteriemas are prone to occur through the diminished susceptibility of the host There may not be an appreciable leukocytotic response Chemotherapy may not be effectual though it is worthy of an intensive and persistent trial

Brucellosis Pneumonitis —*Pulmonary involvements are not infrequent in* the course of brucellosis Cough chills pleural pain and mucopurulent or blood streaked sputum are encountered as initial symptoms in a certain proportion of instances in other patients evidences of respiratory infec tion may develop weeks or months after the onset of the systemic disease

The pulmonary lesion may persist for weeks or months with eventual resolution In a certain proportion of the patients a chronic nontubercu lous pneumonitis is encountered treatment with streptomycin (p 103) has yielded disappointing results

Plague Pneumonitis —Plague pneumonitis occurs as a primary infection though it may be secondary to a septicemia in the bubonic variety of the disease (p 322)

The primary pneumonic form which is transmitted by the rat flea incubates for two or three days after which there is an acute onset with extreme toxemia increasing and intense cyanosis dyspnea and copious thin bloody sputum containing countless numbers of the plague organism

The primary plague pneumonitis has a case fatality rate that approxi mates 100 per cent Intensive treatment with streptomycin (p 103) suc cessful experimentally merits clinical trial in conjunction with anti plague serum

Tularemia Pneumonitis —Pulmonary lesions are present in more than 90 per cent of those who succumb to tularemia The common lesion is a bilateral and diffuse pneumonitis which tends to necrotization Pleural effusion occurs frequently A specific therapeutic effect follows intensive streptomycin injections (p 103)

Friedlander Pneumonitis —The *Bacillus mucosus capsulatus* may produce a lobar type of pneumonia or an acute pneumonitis The clinical features are not dissimilar except for the physical signs and the roentgenological appearances A specific therapeutic effect follows intensive streptomycin injections (p 103)

Spirochetal Pneumonitis —The fusospirochete occasionally sets up an *ulcerogangrenous pneumonitis* The condition is suspected upon the ap pearance in the oropharynx of *trench mouth* or *Vincent's angina* (p 355) The sputum is heavily laden with the characteristic organisms as demonstrated by simple stains and darkfield examination

Specific responses are occasionally encountered following the systemic introduction of penicillin or an arsenical (p 116) preferably *mapharsen* in dosages of 60 mg intravenously

Acute Exacerbation of Chronic Pulmonary Disease —Acute pneumonitis is often superimposed upon chronic infection of the respiratory tract Thus it provides periods of activity in *emphysema* (p 2056) *chronic bron chitis pneumoconiosis* (p 2062) *bronchiectasis* (p 2059) *bronchial asthma* (p 2101) and *chronic pneumonitis* (p 2199) whether tuberculous or nontuberculous

Many of the acute exacerbations of chronic pneumonitis are caused by

secondary invaders such as streptococci staphylococci and pneumococci Hence chemotherapy is worthy of trial even if it is clearly demonstrable that the more fundamental bacterial invader (tubercle bacillus *B mel itensis*) is drug resistant

Hypostatic Pneumonitis —Hypostatic or terminal pneumonia has been characterized as the old man s friend It is observed as well in debili tated infants alcoholics and younger patients who suffer from chronic disease of great intensity It is particularly apt to occur in *cardiacs* who have universal chronic passive congestion in addition to hypostasis at the pulmonary bases

Hypostatic pneumonia is most insidious in its manifestations There are rarely significant subjective symptoms Often the clouded conscious ness of the patient prevents him from reporting distress of even greater severity constitutional reactions are minimal due to the inability of the tissues of the host to respond to the challenge of the invader The course of the disease is progressively unfavorable due to the weakened host reac tion rather than the virulence of the pathogen

Physical Examination

The physical examination in acute pneumonitis reveals deceptively little in the early days of the disease At most there are areas of dimin ished breath sounds crepitant rales or inconstant bronchovesicular breath ing there may be slight dulness to percussion Often it is not until the disease has run its course and the temperature approaches normal that the significant physical signs become audible

The clinician occasionally is able to suspect the nature of the etio logic organism from the clinical manifestations In the midst of an epi demic of influenza or virus pneumonitis the prevailing culprit is suspected but surprises are often in store for those who do bacteriological examina tions A history of handling a sick or dead exotic bird or barnyard fowl suggests *psittacosis* (p 473) or *ornithosis* (p 475) the Friedlander bacil lus invasion often starts with *hemoptysis marked dyspnea cyanosis* and sputum that is thick gelatinous and brick red The 1918–1919 epidemic of influenza virus pneumonia was characterized by the early combination of cyanosis pulmonary edema and a sense of well being

Laboratory Examinations

The laboratory examinations in acute pneumonitis are decidedly un satisfactory

Hemogram —There may be a *leukocytosis* in pneumococcal staph ylococcal and streptococcal infections but the other types of invasion produce little or no alterations in the hemogram Indeed a *leukopenia* may be encountered in the early stages of pneumonitis due to the Fried lander bacillus in influenzal and viral pneumonitis and with bone marrow depression due to intense invasions with pneumococci staphylococci and streptococci

Blood Culture —Bacteriemias are rarely encountered in acute pneumo nitis Their presence indicates a virulent invasion with markedly dimin ished host resistance and points to an ominous prognosis

Bacteriology of Sputum and Pleural Fluid —The sputum examination is

conducted by *direct smear* (p 50) for identification of spirochetes or mycoses the *gram stain* (p 52) for detection of the preponderant organism and a *carbolfuchsin* stain to demonstrate the tubercle bacillus Cultures are planted on special media (p 53) or injected into the mouse peritoneum

The bacteriological examination of the *sputum* should not be omitted even in the presence of an obvious epidemic of virus pneumonitis or influenza An attempt is made to isolate the predominant organism There can be no doubt as to the pathogenicity of *pneumococci* of Types I II IV V and VIII of *H influenzae* or *H pertussis* of *E typhosus M tuberculosis B anthracis B melitensis P pestis P tularensis B mucosus capsulatus the mycoses beta hemolytic streptococci of Group A* or *hemolytic staphylococcus aureus* With a mixed culture the suspicion is strong that the infection has been caused by a virus such as is present in virus pneumonitis influenza grippe' measles psittacosis ornithosis lymphocytic choriomeningitis or rickettsial disease

When acute pneumonitis is complicated by a *pleural effusion* the bacteriology of the exudate leaves little doubt as to the nature of the organism

Skin and Serologic Tests—On occasions the etiology of an acute pneumonitis is revealed by skin and serological reactions (p 59) The former are useful in *coccidioidomycosis brucellosis* and *tuberculosis* Serologic tests (p 59) are revealing in *typhoid fever psittacosis ornithosis influenzal virus infection tularemia* and the *rickettsia*

Roentgenography

Roentgenological examination is invaluable in the diagnosis and evaluation of acute pneumonitis Since we have made a practice of taking films of patients recently recovered from what has seemed to be a simple upper respiratory infection we have confirmed the experiences of medical officers in army camps who find an extraordinary number of pulmonary infiltrations in individuals who presented neither physical signs nor laboratory evidences of alveolar involvement

The earliest roentgenographic lesion is that of increased prominence of the *hilar shadow* Later the *bronchovascular markings* appear intensified and an *infiltration* extends fanwise from hilum toward periphery usually fading out into normal parenchyma before reaching the lung border The site for the infiltration is most often a *basal lobe* but middle and upper lobe involvements may be observed The infiltrations are characteristically light mottled and feathery , lung markings are usually visible through the shadow the lesions have a tendency to become more extensive and to migrate or successively involve a number of different areas (Fig 497)

In most instances the lesions are transitory and disappear in a week or ten days In moderately severe illnesses they persist for several weeks With *necrotization* small areas of excavation appear at times with fluid levels (p 2209)

There may be many disturbing variations in the roentgenographic picture A soft circumscribed lesion at an apex strongly resembles an early *tuberculous infiltration* (p 259) scattered nodular lesions are suggestive of extensive *tuberculosis* or *metastatic malignancy* (p 2078) *miliary infiltrations* are observed as in tuberculosis

Course

The course of acute pneumonitis is a variable and depends upon the host reaction and the nature of the invading organism As is to be anticipated the pulmonary complication is grave and often agonal in infancy the aged the debilitated those who suffer from chronic disease and alcoholics On the other hand virus pneumonitis pursues an almost universally favorable course with uncomplicated recovery within a few to several days

Complications

The complications of acute pneumonitis vary according to the organism and the factor of tissue susceptibility The more common untoward aftermaths include pulmonary necrosis and abscess formation pleural effusion with empyema pulmonary edema and atelectasis and the later development of emphysema bronchiectasis and pulmonary fibrosis

Pulmonary Necrosis and Suppuration —The presence of a prolonged or severe infection of intractable paroxysmal cough inexplicable cyanosis urgent dyspnea and disproportionately grave toxemia indicates the possible presence of a *necrotizing pneumonitis* Without x rays the diagnosis at best can be hazarded by the attendant circumstances since the sputum rarely is grossly purulent or putrid The organisms more often involved include *Streptococcus haemolyticus* hemolytic *Staphylococcus aureus* B *mucosus capsulatus* B *anthracis* B *tularensis* B *melitensis* and the influenza virus

Necrotizing pneumonia carries a *grave prognosis* though recovery may be encountered *abscess formation* may be followed by *spontaneous drainage* and *recovery* rupture into the pleura is productive of an *empyema thoracis*

Pleural Effusion and Empyema Thoracis —Sterile pleural effusions are frequently encountered in streptococcic hemolytic infections and tularemia Small amounts of pleural fluid probably collect in most moderate or severe examples of acute pneumonitis but these are rarely revealed except on roentgenograms

The complication of empyema thoracis has been greatly diminished since the introduction of anti infective agents Hemolytic streptococci staphylococci and the Friedlander bacillus are frequent provocative agents in this complication

Pulmonary Edema —In the 1918–1919 epidemic of influenza pneumonitis pulmonary edema was often encountered The patient literally drowned in his own secretions which may have been stimulated by *simple irritation* or a mechanism analogous to an *allergy*

Atelectasis —Localized areas of pulmonary atelectasis are frequently seen in patients who have died of pneumonitis Often the diagnosis is not possible even with x rays occasionally the complication is suspected through the appearance of unaerated portions of the lung

Emphysema Bronchiectasis and Pulmonary Fibrosis —The complications of emphysema bronchiectasis and pulmonary fibrosis are rarely demonstrable until many years after recovery from acute pneumonitis In most instances the connecting link has been lost It was most surprising after the 1918–1919 epidemic of influenzal pneumonitis to observe how few of those who had been seriously ill suffered permanent pulmonary damage

Prognosis

The prognosis of acute pneumonitis varies between *high optimism* and *grave pessimism* The factors that require consideration include the *nature of the invading organism* and the *general resistance of the patient*

Unfavorable—Any pneumonitis is of *grave prognostic significance* in infancy the aged and the debilitated in those who suffer from chronic disease in pregnancy and alcoholism in lung fields damaged by emphysema bronchiectasis chronic bronchitis pulmonary fibrosis or pulmonary tuberculosis The disease is serious in the allergic particularly those with bronchial asthma

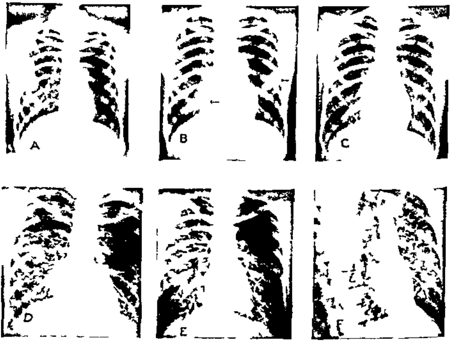


Fig 499—Roentgenograms demonstrating the development of bronchiectasis in a case of atypical pneumonia *A* Healthy chest at the time of induction into the Army *B* Multiple foci of pneumonic involvement *C* Clearing of the pneumonia in the left pulmonary field but persistence over a period of several months at the right cardiophrenic angle with some evidence of atelectasis at this site *D* *E* and *F* Serial bronchograms over a period of four months demonstrating no change in the degree of bronchiectasis of the lower lobe of the right lung

Pneumonitis due to a virulent invader is also a cause of concern to the practitioner who looks with evil foreboding upon infections with the organisms of anthrax tularemia plague coccidioidomycosis the Friedlander bacillus hemolytic staphylococci brucellosis psittacosis and actinomycoses Evil prognostic signs include progressive dyspnea and cyanosis a rise in the temperature curve leukopenia bacteriemia and spread of the infection despite chemotherapy

Favorable—Virus pneumonitis or a mild influenzal pneumonia in an otherwise healthy child or adult carries very little threat of complication

* Kay in Arch Int Med Feb 1945

or mortality The outlook is bright also if the sputum examination reveals sulfonamide or penicillin susceptible organisms

Treatment

The treatment of acute pneumonitis follows along the lines outlined for the management of *lobar pneumonia* (p 2171) The same *supportive measures* and *nonspecific medications* including *oxygen therapy* are indicated *hypermedication* (p 2183) is avoided in like manner It is only in the matter of specific therapy that divergencies arise these involve the exercise of judgment according to the principles next to be discussed

Antibiotic Treatment—Indications for the use of antibiotics in acute pneumonitis are absolute and relative *Absolute indications* exist when sputum examination reveals sulfonamide or penicillin sensitive organisms such as hemolytic streptococci staphylococci or pneumococci for streptomycin (p 104) when the pneumonitis is caused by *H influenzae M tuberculosis K pneumoniae* (Friedlander) *P tularensis* or *B melitensis*

In private practice absolute indications are the exception The results of sputum culture at best may not be obtained until after a lapse of several days The physician must rely on his judgment and clinical experience in making the decision as to the use of the antibiotic in general and the specific agent in particular Most attacks of acute pneumonitis are due to a specific virus that is resistant to all antibiotic preparations From the purely academic viewpoint it is futile to administer any of these products in the presence of virus pneumonitis Nevertheless it is our practice to place great reliance upon *penicillin* (p 106) particularly since this preparation can do no harm and if it does nothing else controls sensitive secondary invaders and may prevent complications Unless a virus pneumonitis is mild and the patient a normal healthy individual it is our practice to conduct a therapeutic test with penicillin for at least three days We administer an initial dose of 50 000 units and continue with 25 000 units every three hours during the trial period We are insistent upon penicillin therapy if the patient is acutely ill if the attack has been protracted if the afflicted individual is an infant an aged person a debilitated invalid a pregnant woman or one who suffers from pre existent chronic disease particularly in the upper respiratory passages If the therapeutic trial of three days does not produce a striking effect penicillin therapy is discontinued unless the bacteriologic report reveals a known sensitive organism We initiate or repeat the trial penicillin period on the appearance of complications in the presence of a protracted infection and with recurrence or relapse

The administration of penicillin causes practical difficulties when the patient is confined to his home Intramuscular injections can be given only if the physician or a trained nurse is in frequent attendance or if some member of the household has learned to give a hypodermic If these favorable circumstances do not prevail oral doses of penicillin may be administered using five times the intramuscular dosage at three hour intervals or a single injection of 300 000 units of the wax oil mixture may be deposited to maintain penicillin concentrations between the last visit to the patient at night and the next visit the following day

Finally if penicillin therapy is impractical or ineffectual *sulfonamide* is substituted using sulfadiazine 3 0 or 4 0 gm (45 to 60 grains) as the

primary dose and 1 0 gm (15 grains) every four hours thereafter exercising the usual precautions (p 88) *Streptomycin sensitive organisms* require the larger dose of 500 000 units (0 5 gm) by intramuscular injection every four hours at least for a week to ten days

CHAPTER 104

THE RESPIRATORY SYSTEM CHRONIC TUBERCULOUS AND NONTUBERCULOUS PNEUMONITIS PULMONARY SUPPURATION HELMINTHIASIS

Chronic Tuberculous Pneumonitis
Chron c Nontuberculous Pneumonitis
Furunculosis of the Lungs
Miliary Tuberculosis (p 261)
Pulmonary Amebiasis (p 526)
Pulmonary Helminthias s (Distomiasis)
Aputrid Lung Abscess
Putrid Lung Abscess

CHRONIC TUBERCULOUS PNEUMONITIS

After the first year of life there is probably no such thing as a normal lung Each of us by then has had a variable dose of tuberculosis it becomes the duty of the practitioner to detect the extent of the damage and to estimate the degree of activity in terms of the ubiquitous chronic inflammation

The Varieties of Tuberculous Pneumonitis—*End organ manifestations* of chronic tuberculosis are the present concern Before proceeding further with the reading of this section the practitioner is urged to review the material on the *tubercle bacillus* (p 252) Attention is particularly drawn to other respiratory consequences of invasion with the acid fast bacillus these include the *primary infection* (p 258) *miliary tuberculosis* (p 261) *tuberculous lobar pneumonia* (p 2176) and *tuberculous pneumonitis* (p 2199)

Pathology—The pathology of chron c tuberculous pneumonit s embraces a wide variety of tissue changes which have in common *fixed tissue responses* rather than polymorphonucl r reactions and the s multaneous presence of *processes of destruction and repai* When the mechanisms of healing exceed those of destruct on there is resultant *fibrosis* and *cicatrization* when the factors of destruct on exceed those of repair the predominant manifestation is *death of tissue* with *caseation* and *ca tat on*

The National Tube ulos s Association and the Amer can Sanatorium Association have adopted the following classification based upon the extent and nature of the pulmonary lesions

I Minimal Lesion
- *a* Slight infiltration without demonstrable cavitation
- *b* A small part of one or both lungs Total olume of involvement regardless of distribution shall not exceed the equivalent of the volume of lung tissue which lies above the second chondrosternal junction and the spine of the fourth or body of the fifth thoracic vertebra on one side

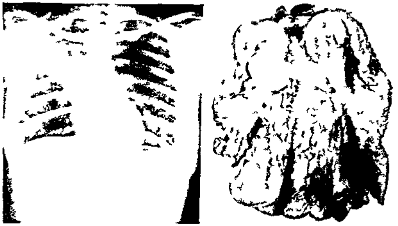
II Moderately Advanced Lesion
Lesion allowable under moderately advanced One or both lungs may be involved but the total involvement shall not exceed the following limits
- *a* Slight disseminated infiltration or fibrosis which *may* extend *through not* more than the equivalent of the volume of one lung
- *b* Severe infiltration with or without fibrosis which may extend through not more than the equivalent of one-third the volume of one lung

c Any gradation within the above limits
d Total diameter of cavities if present, should not exceed 4 cm
III Far Advanced Lesion
A lesion more extensive than under moderately advanced or definite evidence of greater cavity formation

CLINICAL MANIFESTATIONS

The clinical manifestations of chronic tuberculous pneumonitis are legion The condition may be asymptomatic it may become apparent through systemic or respiratory phenomena

Asymptomatic Tuberculous Pneumonitis—The majority of instances of chronic tuberculous pneumonitis are *asymptomatic* The practitioner often notes with amazement that his patient has advanced pulmonary changes without history or present evidences of the conflict that must have waged within the thorax Occasionally the patient recalls a period of vague malaise in the recent or remote past but the sum total of the complaints



A B

Fig 500—Caseous pneumonic tuberculosis A X ray demonstrates involvement of the right upper lobe and several cavities B Coronal section of the right lung in the same case removed by pneumonectomy *

is relatively inconsequential in comparison with what is seen on radio graphs

The recognition of asymptomatic tuberculous pneumonitis has important clinical connotations for the practitioner With more mature experience he recognizes that the demonstration of pathological change constitutes only the beginning of the investigative problems The more difficult dilemmas that require elucidation are the estimation of the *degree of activity* in the infectious area and the *relationship* which this activity bears to presenting symptoms and signs

In those patients in whom the tuberculous lesion is completely arrested the pathological manifestations may be compared to archeological ruins they have historical significance but little realistic present importance It is just as serious a blunder to make an invalid of a patient with ancient pulmonary pneumonitis as it is to overlook that diagnosis in one who is suffering from activity Nor is it to be forgotten that the patient

* Hochberg Surgical Clinics of North America April 1945

with chronic tuberculous pneumonitis is subject to the same ills as the nontubercular patient he may develop lobar pneumonia chronic paranasal sinusitis acute appendicitis syphilis or rheumatic fever without any bearing upon the acid fast invasion

Estimation of Activity—In his estimation of clinical activity the practitioner relies upon the sum total of the evidence produced by systemic manifestations (p 2201) and laboratory data (p 2205) Rigid criteria of arrest are required to be met in every detail these include a protracted period in which there is neither absolute nor relative pyrexia (p 2201) maintenance or gain of weight (p 2201) absence of tubercle bacilli from sputum gastric content or stool (p 3729) radiologic evidences of healing without demonstration of fresh areas pointing to more extensive involvement a normal sedimentation time and a feeling of well being

Chronic Tuberculous Pneumonitis and the Presenting Symptoms—With or without activity the practitioner is required to adjudicate the relationship that exists between the tuberculous lesion and the presenting symptom It is a wise discipline to initiate the investigation with the prejudice that there is some other operative factor Under these circumstances the tubercular lesion is incriminated only after a meticulous survey in which other phenomena are eventually eliminated from the calculations

Systemic Manifestations—The systemic manifestations of chronic tuberculous pneumonitis usually precede the arresting respiratory complaints next to be described (p 2202) The more prominent constitutional derangements include fever sweating malaise lassitude fatigue loss of weight tachycardia pallor digestive symptoms nervous and psychic alterations and changes in menstruation and sexuality

Fever—The most important single method of determining activity in chronic tuberculous pneumonitis is the accurate registration of a fever chart This involves a recording of the rectal temperature at least four times daily The interpretation of the readings (p 19) is elsewhere discussed in detail The presence of an *absolute pyrexia* by which is meant a daily rise to in excess of 100 F leaves little doubt as to the presence of some constitutional disturbance Preceding and following the absolute pyrexia most patients exhibit a *relative pyrexia* which is worthy of close scrutiny Under these circumstances the readings may never exceed 100 F at any time during the day or night However a diurnal variation in excess of 1 F is recorded and this finding in our experience has important significance from the standpoints of prognosis and diagnosis

Sweating—The characteristic night sweats of tuberculosis are only arely present in the beginning of the affliction Most often they occur when there are considerable variations in temperature due to excavation in the lungs or the presence of secondary suppuration

Malaise Lassitude and Fatigue—The vague symptoms of malaise lassitude and fatigue are early accompaniments of tuberculous toxemia The patient notes that he is exhausted before the day s work has begun he tires more easily and more readily in the course of his daily routine and returns home too weary for anything other than rest and sleep

Loss of Weight—Loss of weight is often a herald symptom of activity in chronic tuberculous pneumonitis Without alteration in diet or a significant elevation of the basal metabolic rate the weight progressively and

gradually falls off until clothes that previously fitted snugly hang as loosely as the garments of a scarecrow

Tachycardia—Tuberculous toxemia is suggestively *adrenergic* (p 1391) and the patient often develops a *tachycardia* out of proportion to the degree of pyrexia *Malar flushing* further attests to vasomotor instability its appearance often corresponds to the episodes of sweating

Pallor and Anemia—The tuberculous patient often appears pale without necessarily demonstrating any striking change in the hemogram Secondary anemias however accompany the more advanced stages of tuberculosis particularly when there has been significant blood loss through hemoptysis

Digestive Disturbances—Digestive disturbances are almost universally present with chronic tuberculous pneumonitis *Loss of appetite capriciousness as to food intake* and *constipation* often give the impression that the patient is suffering primarily from a disturbance of the gastro intestinal tract In advanced tuberculosis with violent coughing there is often associated *nausea* and *vomiting* The emetic' cough does not necessarily distinguish tuberculosis since it may also be present in any condition in which the cough is paroxysmal or the sputum is putrid as in *bronchiectasis* (p 2059) or *chronic putrid lung abscess* (p 2215)

Nervous and Psychic Disturbances—Most patients with tuberculosis show distinct changes in mood The general feelings of malaise lead to *irritability impatience* and *depression* Occasionally a patient exhibits the *euphoria* which has been overemphasized as a personality characteristic in tuberculosis

The impact of the chronic pneumonitis upon the psyche of the patient is of more than passing importance in prognosis Restless untrusting and disorganized individuals are very prone to do badly, persons of character courage and loyalty have a better chance for eventual restitution to normal

Changes in Menstruation and Sexuality—In cases of early tuberculosis *oligomenorrhea* and *amenorrhea* are often herald manifestations of the tuberculous toxemia The reputation of the tuberculous toward *eroticism* is probably dependent more upon confinement to bed than the consequences of the disease

Respiratory Symptoms—The respiratory symptoms of chronic tuberculous pneumonitis include cough expectoration hemoptysis pain in the chest dyspnea and hoarseness

Cough—Cough is usually the earliest the most persistent and the most constant respiratory manifestation of chronic tuberculous pneumonitis With small infiltrations it is unproductive and irritating with death of tissue and excavation the cough becomes looser and more productive Paroxysms of cough particularly if associated with fetid sputum cause associated nausea and vomiting (*emetic cough*)

Expectoration—The amount of expectoration in chronic tuberculous pneumonitis varies from the small quantities of mucus present in the early stages of infiltration to the large quantities that are expelled when a cavity is evacuated Infants children and those who have not learned to expectorate often swallow the sputum so that it is necessary to look for the bacillus in the *gastric content* (p 3726) or the *stool* (p 3727)

The character of the sputum is variable In the early stages it is gray and not particularly thick Later it may become purulent putrid or blood stained depending upon the local pathology in the pulmonary tree

Hemoptysis—Blood spitting occurs at one time or another in most patients with pulmonary tuberculosis Generally the quantity is small and the sputum is merely streaked or spotted However copious and exsanguinating hemoptyses may occur without necessary relationship to the activity of the disease Usually large bleedings are due to ulceration of the walls that traverse *tuberculous cavities* In women there is a tendency toward blood streaking at the menstrual time attesting to some alteration in the coagulative mechanism (p 1108)

Moderate to large hemoptyses are associated with secondary manifestations due to *blood loss shock* and the *nervous upset* Blood may be *vomited* when large quantities have been swallowed Seepage of blood into the bronchial tree gives rise to a *posthemorrhagic tuberculous pneumonia* with pyrexia and roentgenographic evidences of fresh infiltration

Pain in the Chest—The initial pulmonary infiltrations are often situated just beneath the pleura The overlying fibrinous exudate gives rise to pain which may be referred to local or distant areas Under the latter circumstance the site of the distress may be misleading since there may be reference to the neck down the shoulder or in the hypochondrium The interpretation of the misleading symptom is clarified by physical examination or the roentgenographic findings

Hoarseness—Hoarseness may result from the trauma to the larynx as the result of incessant coughing It requires inspection of the vocal cords since *tuberculous laryngitis* (p 2161) is an ominous and intractable complication

Dyspnea—The insignificant amount of dyspnea that is present in advanced chronic pneumonitis is often a source of astonishment to the clinician So great is the factor of safety in the pulmonary fields that patients present themselves with advanced destruction of respiratory tissue and relatively inconsequential shortness of breath

PHYSICAL EXAMINATION

The physical examination in chronic tuberculous pneumonitis has greatest value in the incipiency of the disease Careful and repeated surveys of the supra and infraclavicular regions anteriorly and posteriorly may reveal the presence of reasonably constant *crepitant or subcrepitant rales* heard best at the end of expiration or after a cough Cog wheel respiration at an apex is a suspicious but not pathognomonic sign Later manifestations include the appearance of areas of relative dullness narrowing of the shoulder strap diminished excursion at an apex and zones of suppressed breath sounds or bronchovesicular breathing with increased fremitus

Large *cavities* produce the classical phenomena of cracked pot percussion and amphoric or cavernous breathing *massive effusions* (p 2032) give flatness absent sounds and contralateral cardiac displacement *fibrosis* and *collapse* result in ipsilateral mediastinal displacement *endobronchial secretion* is made manifest by persistent rales

The extent and nature of the pulmonary lesions are only roughly approximated by audible phenomena the practitioner insists upon x ray examination in the presence of any respiratory symptoms or signs

ROENTGENOGRAPHY

The roentgenographic manifestations of chronic pneumonitis are revealed by x rays taken in postero anterior and lateral positions These

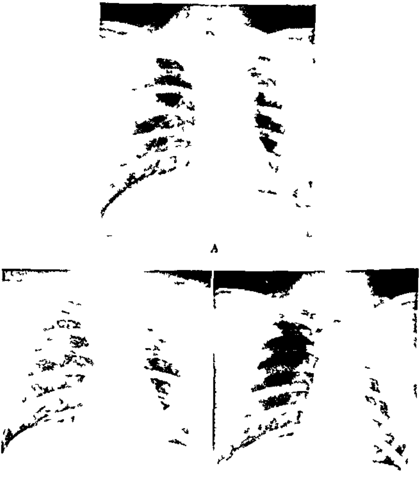


Fig 501 —Left caseous pneumonic lesion A The cavity is crossed by the fifth rib posteriorly B Following subperiosteal resection of the upper three ribs The cavity is now smaller and is displaced downwards and inwards and is now opposite the medial part of the sixth rib C Following the resection of the fourth fifth and sixth ribs and the lower third of the scapula

disclose infiltrations areas of fibrosis consolidations and excavations they demonstrate with clarity the primary infection of tuberculosis at a time when there may be no appreciable physical findings *Bronchography* is of additional value in outlining bronchiectasis or a cavity

* Hochberg Surgical Clinics of North America, April, 1945

Serial films provide the best over all picture of the progress of the disease they are invaluable in the establishment of the therapeutic indications and the estimation of accomplishments

The practitioner must guard against *over interpretation* of pulmonary shadows *silhouettes* do not indicate the nature of the etiologic factor which is best determined by bacteriological examinations of sputum (p 3719) *shadows* do not establish the degree of activity (p 2201) which rests upon the evaluations of many significant data

ENDOSCOPY

A bronchoscopic survey may provide exact data concerning the presence of bronchiectasis and cavities it permits collection of secretion from which bacilli may be isolated when the sputum specimens are negative

LABORATORY FINDINGS

In chronic tuberculous pneumonitis valuable data are provided by examinations of sputum gastric content stool and blood

Sputum —The collection of sputum requires attention to details elsewhere outlined (p 3719) Repeated examinations are necessary using pains taking and time consuming technics Carbolfuchsin stains are scrutinized for acid fast bacilli (p 49) With negative sputum the specimens are concentrated and may require injection into guinea pigs (p 62)

Gastric Content and Feces —In children and those who have not learned to expectorate the organism of tuberculosis may be demonstrated in gastric content or stool The material is concentrated before staining and a specimen likewise may be injected into the guinea pig

Hemogram —Ordinarily there is no specific diagnostic change in the hemogram of chronic tuberculous pneumonitis With progression of the disease and following blood loss evidences of secondary anemia are to be expected

There has been considerable study of the changes in the leukocytes The total count rises while the differential spread shows a shift to the left when there is acute progression as in galloping consumption or a miliary tuberculosis Resumption of the normal count with a restoration of the ordinary differential appearance has some favorable prognostic implications In our experience however these data are over emphasized and over interpreted by enthusiasts

Sedimentation Rate —The erythrocyte sedimentation rate is of some value in estimating the progress in a chronic tuberculous pneumonitis It may be rapid before there is demonstrable pyrexia and it may remain rapid after the temperature has returned to normal but before activity has ceased Thus it provides a delicate index by which progress and the restoration to normal may be gauged

Tuberculin Tests —After the first year of life tuberculin tests have very little diagnostic or prognostic value A *negative response* (anergy) in the presence of demonstrable tuberculosis points to a serious defect in the resistance mechanism as is seen in sarcoidosis (p 3271) a positive test (p 264) is indicative of sensitization to the protein of the bacillus but is not to be regarded as a certain proof that the patient suffers from the disease or that the symptoms are related to an acid fast infection

The extent and nature of the pulmonary lesions are only roughly approximated by audible phenomena the practitioner insists upon x ray examination in the presence of any respiratory symptoms or signs

ROENTGENOGRAPHY

The roentgenographic manifestations of chronic pneumonitis are revealed by x rays taken in postero anterior and lateral positions These



A



B C

Fig 201 —Left caseous pneumonic lesion A The cavity is crossed by the fifth rib posteriorly B Following subperiosteal resection of the upper three ribs The cavity is now smaller and is displaced downwards and inwards and is now opposite the medial part of the sixth rib C Following the resection of the fourth fifth and sixth ribs and the lower third of the scapula *

disclose infiltrations areas of fibrosis consolidations and excavations they demonstrate with clarity the primary infection of tuberculosis at a time when there may be no appreciable physical findings *Bronchography* is of additional value in outlining bronchiectasis or a cavity

* Hochberg Surgical Clinics of North America April, 1945

suspicion of an intrathoracic lesion and of making repeated and careful examinations of sputum gastric contents or feces for demonstration of the specific organism Whether the patient has a lobar pneumonia a nonpneumonic pneumonitis a chronic bronchitis a bronchiectasis a pneumoconiosis a lung abscess a cavity or a fibrosis the tubercle inflammation may be causative precedent or superimposed

Errors of Commission —As serious as the error of overlooking a tuberculous infection is that of concluding that chronic pneumonitis is necessarily tuberculous The patient who has demonstrable chronic pathologic changes in the lungs and in whose sputum tubercle bacilli cannot be demonstrated may suffer from a large variety of nontubercular disturbances particularly with secondarily imposed infection These include *emphysema bronchiectasis lung abscess neoplasms* of the bronchus or lungs *endobronchial foreign bodies* with *atelectasis* or the necrotization stage of an acute pneumonitis Clinicians are recognizing also with increasing frequency the pulmonary mycoses particularly those caused by actinomyces and the coccidioides of desert or valley fever (p 499) The latter are definitively diagnosed if the sputum is examined directly for the presence of the causative organism (p 3719)

PROGNOSIS

Prognostication in chronic tuberculous pneumonitis is as difficult a clinical discipline as the practitioner encounters Many variables require consideration the only certainty is the eventual presence of surprises and disappointments

The *unfavorable* prognostic indications include extreme youth or extreme old age the presence of the disease in adolescent females bilateral involvement the occurrence of caseation the development of cavities greater than 2 cm in diameter marked constitutional manifestations failure to respond to treatment persistence of bacilli in sputum evidences of local spread in the pulmonary field evidences of complications in distant organs particularly enteritis and laryngitis repeated hemoptyses the early development of a secondary anemia a marked leukocytosis with a shift to the left a persistent pyrexia tachycardia and rapid sedimentation rate failure to gain weight consistent loss in weight the appearance of nervous and psychological deterioration as evidenced by restlessness discouragement lack of cooperation rebellion with regard to therapy the presence of a coincidental pregnancy respiratory infection diabetes mellitus or allergy

Favorable prognostic signs include the absence of the above ominous appearances loss of bacilli from the sputum disappearance of the signs of activity (p 2201) a favorable response to therapy and the ability to resume normal activities without the development of exacerbation

TREATMENT

The treatment of pulmonary tuberculosis is subdivided into the management of the infection and measures aimed at the local respiratory lesion

Treatment of the Tuberculosis.—Specific and nonspecific measures are available for the treatment of the tuberculosis These are elsewhere outlined in detail *specific therapy* with *streptomycin* (p 103) holds promise

COURSE

The course of chronic tuberculous pneumonitis is unpredictable In favorable instances the lesion undergoes *fibrosis* and *calcification* in un favorable instances nothing seems to arrest tissue destruction and the lesion progresses until it proves fatal

Most often the course of chronic tuberculosis is punctuated by *remis sions* and *exacerbations* The factors which determine the balance of power are not always clear Certainly the hygienic measures of the therapeutic program (p 267) favor arrest and ignorance or neglect of the principles of good living intercurrent infection anxiety and psychogenic traumas court disaster

COMPLICATIONS

The complications of chronic pneumonitis are local and systemic Lo cally the lesion may advance and involve other previously free areas of the respiratory field *caseation* and *cavitation* occur with tissue destruc tion *tubercular laryngitis* (p 2161) is encountered the *overlying pleura* becomes involved when the lesion approaches the serosal surface second ary infection leads to the superimposition of an *acute lobar* or *broncho pneumonic pneumonitis* (galloping consumption) *pleuritis* (p 2219) *pericarditis* (p 1007) or an *empyema thoracis* (p 2222)

With *fibrosis* there are mechanical alterations such as *chest retrac tion lung retraction distortion of the mediastinum* and the development of *cor pulmonale* (p 968) The more dramatic sequels are *pneumothorax* (p 2035) *hemoptysis* (p 2058) and the development of *massive pleural effusion* (p 2221)

The *distant consequences* of chronic pneumonitis include *hypertrophic pulmonary osteo arthritis* (p 2064) *amyloidosis* (p 7) hematogenous spread to other tissues causing *tuberculous meningitis* (p 1462) *tubercu lous enteritis* (p 1860) and *peritonitis* (p 1930) involvements of the *reproductive system* (p 2468) and *urinary structures* (p 2347) and *lymphogenous extension* resulting in lymphadenitis particularly in the hilar cervical and abdominal glands

Reference has been made elsewhere to the *cutaneous phenomena* of tuberculosis (p 3258) The commonest of these are the tuberculids lupus vulgaris erythema nodosum and sarcoidosis

Tuberculosis is also encountered in the presence of other frequent chronic diseases such as diabetes mellitus syphilis and malignancy There is no evidence however to indicate that any of these conditions predis poses to the other

DIFFERENTIAL DIAGNOSIS

There is no respiratory condition which may not be simulated by the tuberculous infection contrariwise there is no respiratory disturbance which may not simulate a pulmonary tuberculosis The recognition of these axioms leads the practitioner ever to suspect the presence of a tuberculosis and ever to self impose the responsibility of proving or dis proving the relationship between the acid fast bacillus and the present ing symptoms

Errors of Omission —The error of overlooking a tuberculous infection is only avoided by the practice of taking roentgenograms upon the slightest

Contraindications include advanced age limitation of respiratory reserve due to a widely disseminated lesion or an intercurrent emphysema bronchiectasis cardiac insufficiency or bronchial asthma, when there is extensive pulmonary destruction marked fibrosis or bronchostenosis and with a large apical cavity

Interruption of the Phrenic Nerve—The purpose of phrenic nerve surgery is the induction of a paralysis of one leaf of the diaphragm The resultant elevation of that structure effects a reduction of from one sixth to one third in the total volume of the ipsilateral lung and thus serves as a form of collapse therapy

The *indications* for the use of phrenic nerve interruption are the same as those for artificial pneumothorax Most experienced phthisiologists however favor the latter which is capable of more exact control and is reversible and revocable at will

Thoracic surgeons often perform a preliminary interruption of the phrenic nerve before instituting extrapleural thoracoplasty

Extrapleural Thoracoplasty—A permanent collapse of the excavated lung may be accomplished by the excision of major portions of the upper three ribs and smaller segments of the lower ribs at a later sitting

The *indications* for extrapleural thoracoplasty consist of failure of more conservative methods of management The general condition of the patient must be sufficiently satisfactory to warrant the risk of a radical procedure the local lesion must be essentially unilateral The indications are best made by an experienced thoracic surgeon and require the participation of the patient in the final judgment

Fairly definite *contraindications* include diminution in renal function the presence of abnormalities in the electrocardiograph a depression of vital capacity a recent or marked loss of weight advanced age marked constitutional manifestations with fever anemia or a shift to the left in the Schilling differential count dyspnea tachycardia amyloid disease and evidences of cardiac or renal insufficiency The patient should be acquainted with the possibility of an operative mortality approaching 10 per cent and of possible failure even with favorable indications in 10 to 25 per cent of instances

CHRONIC NONTUBERCULOUS PNEUMONITIS

There is increasing awareness of the frequency and importance of chronic nontuberculous pneumonitis In general this category of afflictions includes the *sequels of acute pneumonitis* *secondary infections* in lungs that have previously been damaged as the result of some nontuberculous lesion and *primarily chronic inflammatory processes* due to some organism other than the tubercle bacillus

THE SEQUELS OF ACUTE PNEUMONITIS

The complications of certain of the varieties of acute pneumonitis (p 2185) include necrotization suppuration and fibrosis Under any of these circumstances the practitioner is confronted with persistent constitutional manifestations or pulmonary symptoms and signs Serial roentgenograms are required in order to follow the course of events Sputum examinations must be made meticulously with reference to demonstration of the tubercle

for arrest if not cure of tuberculosis (p 266) *Nonspecific treatment* (p 267) embraces rest at home and in the sanitarium climatotherapy dietotherapy heliotherapy psychotherapy, bibliotherapy and occupational therapy

Treatment of the Pulmonary Lesion —In suitable instances, the pulmonary lesion is best treated by some one of the various methods of obtaining *collapse* of the involved portion of the respiratory mechanism The available technics include the induction of *artificial pneumothorax* (p 2033) *interruption of the phrenic nerve* (p 2209), and *extrapleural thoracoplasty* Less favored technics include the introduction of oil into the pleural cavity (*oleothorax*) and *extrapleural pneumolysis* which involves the creation of a space between parietal pleura and inner surface of thoracic cage by

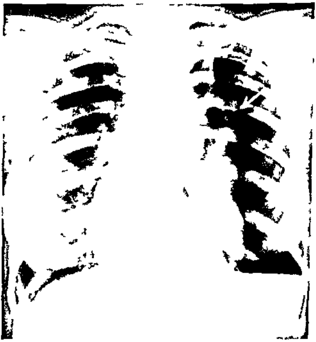


Fig 0? —Artificial pneumothorax Complete collapse of the cavity is prevented by restraining adhesions (arrow) Pneumonolysis is indicated There is fluid at left base

means of some foreign body such as oil paraffin gauze packs muscle implants or rubber balloons

Artificial Pneumothorax —The technic of artificial pneumothorax is elsewhere described in detail (p 2033) The *indications* for inducing an artificial pneumothorax are best discussed by the practitioner with the consultant phthisiologist In general the method is worthy of consideration in patients with active unilateral pulmonary tuberculosis when the course of the disease is stationary or progressively unfavorable with persistence of fever hemoptysis or positive sputum when a large cavity is demonstrable with little disease in the opposite lung in essentially unilateral galloping consumption whether of lobar or bronchopneumonic distribution (p 2199)

* McCombs Internal Medicine in General Practice



Fig 503.—North American blastomycosis of the lungs Note the wedge-shaped shadow projecting into the right lung field*

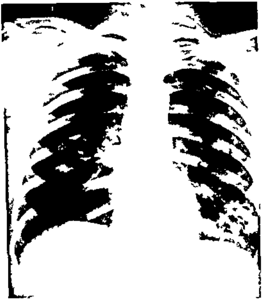


Fig 504.—Torulosis of the left lower lobe Shows inflammatory process with multiple cavities at the base of the left lung†

* Conant and Smith Manual of Clinical Mycology

† Tinney and Schmidt, Medical Clinics of North America, July 1944

bacillus or of any other pathogen capable of producing chronic pulmonary inflammation Failure to clarify the nature of the clinical lesion is sufficient reason for consultation and the performance of bronchoscopy or bronchography

Treatment —Courses of sulfonamide (p 88) penicillin (p 106) or streptomycin (p 103) alone or in combination merit persistent trial Recoveries may be encountered in necrotizations and aputrid lung abscesses if the general condition of the patient can be sustained by general hygienic measures oxygen therapy *aerosolization (p 2041) and repeated transfusions*

SECONDARY INFECTION OF CHRONIC NONTUBERCULOUS PULMONARY LESIONS

Secondary infection may be engrafted upon a lung that is already the seat of an emphysema a chronic bronchitis a bronchiectasis a lipid pneumonitis a pneumoconiosis, an endobronchial or a pulmonary neoplasm or a congenital cyst Under these circumstances a chronic indolent infection is encountered closely simulating a chronic tuberculous pneumonitis

The *diagnosis* is established by the repeated failure to demonstrate tubercle bacilli in sputum, gastric contents or stool Bronchoscopy (p 2026) and bronchography (p 2061) may demonstrate lesions such as endobronchial foreign bodies chronic bronchitis and bronchiectasis

Treatment —Secondarily infected chronic nontuberculous pneumonitis requires probatory antibiotic therapy with oral sulfonamides (p 88) and parenteral and aerosol penicillin (p 106) or streptomycin (p 103) alone or in combination When the infectious element has been arrested bronchographic and bronchoscopic studies are indicated for possible preventive measures relative to reinfection Endobronchial foreign bodies and tumors may be removed with localized bronchiectasis lobectomy or pneumonectomy is worthy of consideration Patients with pneumoconiosis are advised to change their occupational pursuits those with lipid pneumonitis are forbidden to use oily medication intranasally or intra orally

PRIMARY NONTUBERCULOUS CHRONIC PNEUMONITIS

A chronic nontuberculous pneumonitis may be set up primarily in th course of brucellosis (p 314) actinomycosis (p 489) coccidioidomycosis (p 499) fusospirillosis (p 355) tularemia (p 323) glanders (p 327) anthrax (p 292) plague (p 321) blastomycosis (p 493) sporotrichosis (p 495) moniliasis (p 502) torulosis (p 496) and anaerobiosis productive of putrid lung abscess (p 2214)

In each of these several instances the pulmonary pathology the clinical manifestations and the respiratory signs may be identical with those of a chronic tuberculous pneumonitis (p 2199) The *diagnosis* is suspected when the tubercle bacillus cannot be demonstrated in sputum gastric content or stool and when refined bacteriological technics reveal irrevocably the presence of other causative organisms

Treatment —The *treatment* of primary nontuberculous chronic pneumonitis involves the institution of the same general principles utilized in the treatment of tuberculous affections However there is greater hope of accomplishment from therapy with oral sulfonamide (p 88) and parenteral and aerosol penicillin (p 106) and streptomycin (p 103) singly or in combination

tiple they may coalesce to occupy the major portion of the lobe with a clearly discernible fluid level

Treatment—The management of pulmonary furunculosis requires intensive use of *sulfonamide* (p 88) and *penicillin* (p 100) in combination suppurative foci are drained infected vessels are ligated and if possible excised between ligatures

MILIARY TUBERCULOSIS

See p 201

PULMONARY AMEBIASIS

See p 405

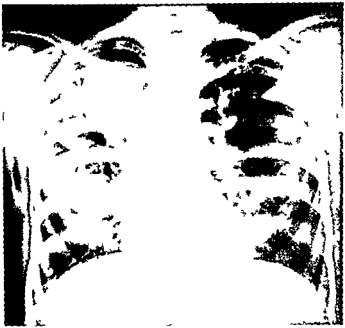


Fig 06—Aspergillosis of the lungs, proved by repeated demonstration of hyphal elements in the fresh sputum The patient gave an immediate wheal like reaction to a vaccine made from his own culture

PULMONARY HELMINTHIASIS (DISTOMIASIS)

Pulmonary helminthiasis is caused by the *lung fluke Paragonimus westermanni*

Geographic Distribution—The lung fluke is indigenous to Japan Korea Formosa Manchuria China Indo China the Philippine Islands Thailand the Malay Peninsula, Assam India New Guinea Java Sumatra Brazil Peru Venezuela Cuba and Yucatan

Life Cycle—The adult fluke lives in the lungs but may also be found in the abdomen brain orbit and pericardium The immature eggs escape in sputum and feces in the latter situation the ova are introduced through swallowed sputum The eggs mature and hatch in water liberating a *miracidium* which enters the first *intermediate snail host* (melania and other genera) In the latter *sporocysts* are formed and from them *cercariae* escape to seek the *second intermediate host* which is represented by several species of *crabs* and *crayfish*

Courtesy of Dr H A Bray From Conant and Smith Manual of Clinical Mycology

FURUNCULOSIS OF THE LUNGS

Staphylococcal invasion (p 153) of the subcutaneous tissues or the kidneys may result in a local infective *thrombophlebitis* The resultant *staphylococcemia* often gives rise to a pulmonary furunculosis on a hematogenous basis

Clinical Manifestations —Pulmonary furunculosis is characterized by extreme *dyspnea prostration cyanosis and tachycardia* Attention may be drawn to the pulmonary lesion by a sudden onset of *pleural pain* when an abscess approaches the lung surfaces The temperature shows wide fluctuations and may vary several degrees in a single day Physical signs are



Fig 505 —Primary coccidioidomycosis of the lungs The patient had skin lesions resembling erythema nodosum when this picture was made Note enlarged hilar lymph nodes and wedge shaped lesion in left lung *

inconsequential and consist of *scattered rales* or occasional areas of *bronchovesicular breathing*

Diagnosis —The diagnosis of pulmonary furunculosis is established by *roentgenograms* which show bilateral sharply demarcated infiltrations resembling a *miliary* type of tuberculosis (p 261) *Sputum cultures* reveal staphylococci but no tubercle bacilli are *demonstrable* The *blood culture* clearly discloses the nature of the invading organism and *suggests* the character of the respiratory complication

Course —With progression of the disease the furuncles tend to produce *pulmonary excavation* The resultant abscesses are usually small and mul

* Courtesy of Dr C F Smith From Conant and Smith Manual of Clinical Mycology

do cavities coalesce to form one larger excavation which becomes apparent on roentgenograms even if it does not give the classical physical signs of cavitation

Course —The fate of the multiple abscesses is variable many are absorbed and disappear with amazingly few chronic changes others rupture into the bronchi and discharge spontaneously Under less favorable circumstances however, the abscess points into the pleura and gives rise to an empyema thoracis (p 2222)

Differential Diagnosis —It is important to differentiate between aputrid and putrid lung abscess since the latter presents an urgent surgical indication whereas the operative interference in aputrid abscess has considerable risk and small prospect of amelioration

Treatment —The aputrid lung abscess requires a therapeutic test with *sulfonamide* and *penicillin* Even if these drugs have failed to be useful in

TABLE 132 —DIFFERENTIAL DIAGNOSIS OF PUTRID AND APUTRID LUNG ABSCESS

	Putrid Abscess	Aputrid Abscess
Etiology	Anaerobes	Aerobes
History	Precedent surgical procedures (tonsils, teeth) under local anesthesia	Precedent pneumonitis
Foul odor to breath	Present	Absent
Foul odor to sputum	Present	Absent
Chest pain	Localized	Rare and not localized
Roentgenogram	Unilocular large cavity	Multiple infiltrations and small cavities
Bronchoscopy	Pus from single bronchus	No localization
Course	Towards chronicity or complications	Towards recovery
Surgery	Urgent	Rarely indicated

the earlier phases of the disease they may benefit the patient at this time After a thorough trial of four to six days the specifics are abandoned unless there is clearcut evidence of improvement *Surgery* is rarely indicated unless there is a single large cavity in an area just beneath the pleural surface The patient is meantime sustained by attention to *general hygienic measures* *oxygen therapy* is indicated for the relief of dyspnea and restlessness and cough *transfusions* aid the resistance of the patient and may tide him over a critical period

PUTRID LUNG ABSCESS (ANAEROBIC)

The putrid lung abscess constitutes an urgent surgical problem and requires differentiation from the aputrid variety (Table 132)

Pathogenesis —Most putrid lung abscesses are *bronchogenic* in origin the vast majority follow surgical procedures particularly *tonsillectomy* and *tooth extraction* done under gen-

In the soft parts of the second intermediate host the cercariae encyst and finally man becomes infected by eating raw crabs and crayfish

Within the human duodenum the *metacercariae* escape from the cyst, penetrate the intestinal wall and migrate through diaphragm and pleura to reach the lungs where they grow into adult forms

Clinical Manifestations —Pulmonary distomiasis may be *asymptomatic* The observed clinical forms include a *generalized systemic illness* with *fever lymphadenopathy muscle pain* and *ulcerations* of the skin

The thoracic type is characterized by *cough* expectoration of blood stained *sputum* containing the ova and evidences of *pneumonitis* or a *pleural effusion* Abdominal and cerebral manifestations have been described but these are apparently less common

Diagnosis —Diagnosis is established by demonstration of the eggs in sputum and feces or in fluid obtained by puncture of a lesion

Treatment —Favorable results have been reported with injections of various preparations of *antimony* including *fuadin* and *stibenyl* (p 132)

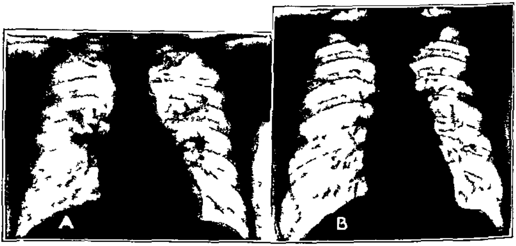


Fig 507 —Lung abscess *A* Bilateral infiltration with a number of cavities resembling tuberculosis *B* Four weeks later resolution *

APUTRID LUNG ABSCESS (AEROBIC)

The aerobic or aputrid lung abscess usually follows *pulmonary furunculosis* (p 2212) or a precedent *acute pneumonitis* (p 2185) caused by the *pneumococcus* the *staphylococcus* the *B mucosus capsulatus* or *hemolytic streptococci* Abscess formation is also observed in the *necrotizing pneumonitis* that is associated with *virus infection* (p 2195)

Clinical Manifestations —The presence of an aputrid lung abscess is suspected when acute pneumonitis pursues a persistent or unfavorable course Efforts at chemotherapy are futile cough continues the febrile and constitutional manifestations do not abate pulmonary signs migrate and extend there is no clearing on the roentgenograms occasionally a small cavitation with a fluid level is recognized

Aputrid lung abscesses are usually multiple the sputum is not foul and the gross signs of cavity are not discernible Only on rare occasions

* Neuhof and Thomas, Arch Int. Med Jan., 1945



Fig. 508.—Multiple abscesses of the lungs. The abscess in the upper part of the left lung is draining spontaneously and clearing up. That on the right side appears as an area of consolidation.*



Fig. 509.—Same case as Fig. 508. Abscess in right lung has been drained by resecting fourth and fifth ribs. Site of operation was determined by study of postero-anterior and lateral films.

fluoroscopically. When the incision is made, the landmark is recognized through the blue discoloration and serves as a useful and reliable guide in locating the lesion.

eral anesthesia they are probably caused by inhalation of pathological anaerobes Only in rare instances is the disturbance *embolic* in origin

Pathology —The anaerobic lung abscess begins as a small or large area of pneumonitis which may resolve in the manner of the ordinary infection or it may undergo necrosis liquefaction and cavitation Surrounding the necrotic zone is a *pyogenic wall* which consists of edematous tissue filled with polymorphonuclear leukocytes and bacteria The abscess usually communicates with a bronchus but the opening may be blocked temporarily by edema of the bronchial mucosa or secretion The communication may be too small to permit of spontaneous drainage

The *right lower lobe* is the commonest site for the lung abscess The left lower lobe is involved slightly less often Localization in the upper and middle lobes is uncommon

The putrid lung abscess is usually single but secondary abscesses may develop as the result of spill over The majority are localized at the periphery of the lobe in which they occur they are partly surrounded by normal tissue A smaller number develop at the root of the lung close to the hilum Many of these however are secondary to bronchial obstruction *Adhesive pleuritis* is present over the great majority of lung abscesses this factor is of utmost importance in surgical therapy

Chronic Abscess —The abscess which persists for two to three months is considered chronic In this stage the wall is thick and shaggy and is composed of dense fibrous tissue radiating out into the surrounding pulmonary field The contents are thick and inspissated, bronchiectasis is invariably present in the surrounding tissues and multiple daughter abscesses occur in the nearby pulmonary fields The involved lung shrinks and the mediastinum is drawn toward the affected side

Clinical Manifestations —The history of a putrid lung abscess usually follows a characteristic pattern Three or four days following the operative procedure the patient notes *fever* and *chilling* at times there may be a shaking *chill* Shortly thereafter *localized pain in the chest* (p 2090) is experienced It is of great importance to chart this symptom through which the surgical approach is later to be pursued Often there is a zone of *circumscribed tenderness* in the region of the subjective pain

Within a few days after the pain has abated the patient notes *cough* (p 2050) At first this is unproductive but often a *foul odor* (p 1660) is observed by patient or physician It is not until the end of another week or for ten to twelve days following operation that *pus is expectorated* at first this is malodorous and profuse later the odor may disappear and the amount is less but blood streaking is very frequent

Physical Examination —The physical examination of the patient with putrid lung abscess reveals little useful information other than the area of *circumscribed tenderness* There may be dulness diminished breath and voice sounds but the character of the lesion and its extent only become manifest through *roentgen examination* and *bronchoscopy*

Roentgenography —Roentgenograms reveal clearly the site of the pathological process the putrid lung abscess is usually unilocular, exact localization is assured by dorsoventral lateral and oblique roentgenograms

SPOT ' LOCALIZATION —To assist in later surgical approaches *spot localization* is necessitated lest the free pleural cavity be entered if the incision is made elsewhere than through the overlying fibrous adhesions For this purpose there is introduced into the intercostal muscles that overlie the region of the abscess a mixture of 0 2 cc of iodized oil and 0.5 per cent of methylene blue The injected mixture appears on the film as a radiopaque landmark The relationship between the center of the abscess and the landmark is established by the position in which there is the least distortion of the distance between the two objects as observed

CHAPTER 105

THE RESPIRATORY SYSTEM: PLEURAL AND MEDIASTINAL INFLAMMATIONS

Acute Pleuritis
Chronic Pleuritis
Acute Mediastinitis
Chronic Mediastinitis

ACUTE PLEURITIS

ACUTE pleuritis usually a secondary and complicating lesion occurs in the dry fibrinous *form* as with *serous effusion and empyema thoracis*

Etiology —Inflammation of the pleura most often results from *extension of an acute or chronic infectious process in the lungs or mediastinal structures* An overlying pleural reaction accompanies such diverse conditions as *lobar pneumonia acute pneumonitis lung abscess pulmonary infarction* and *chronic tuberculous and nontuberculous forms of pneumonitis* Less often the pleuritis results from injury to the *chest wall* or a *subdiaphragmatic* lesion such as *cirrhosis* or an *abscess* of the *liver*

Hematogenous pleural inflammation may accompany *acute rheumatic fever* (p 186) and *disseminated lupus erythematosus* (p 3399) Each of these conditions seems to have a predilection for serous surfaces

Pathology.—Pleural inflammation may be localized or widespread it may involve the surfaces of both lungs *or merely* an isolated patch The affected pleura loses its smooth glistening appearance and becomes roughened there is increased vascularity of pleural and subpleural tissues The lesion may go on to *resolution* with eventual restoration of the pleural surfaces *adhesions* may form between adjacent surfaces resulting in partial or complete obliteration of the pleural sac and the formation of fibrous bands of varying size and thickness

Serous Effusion.—In the serous type of effusion the fibrinous reaction is overshadowed by the accumulation of fluid which may vary in amount from a few drops to several liters With the larger quantities the lung is compressed and the mediastinum is displaced contralaterally Serous fluid is poor in cells but rich in protein Bacteria are rarely demonstrable after absorption masses of fibrin form leaving extensive adhesions between parietal and visceral surfaces In tuberculous effusions fresh subpleural tubercles may be demonstrable by microscopic examination

Empyema Thoracis—With *pus formation* in the pleural exudate an *empyema* develops The purulent inflammation may be acute or chronic diffuse or localized *free or* encapsulated In the latter instance curious clinical phenomena are produced by interlobar or diaphragmatic collections The tendency of the empyema to encapsulate is of signal importance in the surgical approach Opening of the free pleural cavity before *localization* has occurred is associated with considerable risk drainage of the sharply encapsulated empyema is a relatively safe and simple procedure

Pathogenesis—Direct extension explains the mechanism of most instances of acute fibrinous pleurisy and of empyema but the pathogenesis of the tuberculous pleural effusion is more complicated there is much to indicate that the lesion represents a type of *hypersensitivity* that occurs during the phase of hematogenous dissemination of tubercle bacilli At *this time scattered tubercles develop in various portions of the body a subpleural focus* presumably liberates a small number of bacilli into the pleural sacs If the patient's hypersensitivity to the disease is at its height an explosive reaction is evoked and the whole pleural surface pours out large quantities of serous fluid of high protein content, containing

Bronchoscopy—Localization and diagnosis are aided by bronchoscopy (p 2026) by which the abscess cavity is traced to its bronchial subdivision The diagnosis of abscess is confirmed by observation of the secretion and its putrid odor Endoscopic localization is checked with the roentgenological information

Course—The course of putrid lung abscess is difficult of determination Undoubtedly in a large number of instances there is *spontaneous cure* probably through evacuation into the nearest bronchus In other instances the lesion progresses with increased septic manifestations to a *fatal issue* Most often in the observed instances the general symptoms subside and the abscess enters the *subacute* or *chronic stage* The former is defined as between seven and twelve weeks following inception the latter is present in those patients who go longer than twelve weeks

In subacute and chronic putrid lung abscess the fetid sputum is again noted chest pain recurs roentgenograms show a cavity with a fluid level Hypertrophic pulmonary osteo arthropathy develops early and consistently



Fig 510—Putrid lung abscess *A* Diffuse pneumonic infiltration of the right lung after two weeks of hospitalization *B* Six days later pyopneumothorax *

Complications—The complications of neglected putrid lung abscess are many and varied There may be progressive sepsis with a fatal termination at times a spill over abscess involves another area in the pulmonary field *cerebral metastases* are experienced rupture through the pleural membranes produces a putrid empyema with a *tension pyopneumothorax* (p 2223)

Treatment—The putrid lung abscess requires *surgical drainage* in the acute phase With accurate localization it is only necessary to excise one rib The free pleural cavity is well walled off by the pleural reaction and the surgeon need only aspirate the lung locate pus and unroof the abscess in a one stage procedure to obtain an extraordinarily fine result The results in the operative treatment of subacute or chronic abscess are less favorable but far superior to conservative therapy

Surgical therapy must be preceded and followed by antibiotic therapy using penicillin (p 106) and/or streptomycin (p 103)

* Neuhof and Thomas Arch Int Med Jan, 1945

in coccal infections that are progressing favorably with tuberculous involvement there is usually a subsequent serous phase uncontrolled coccal invasions progress to the purulent phase of an empyema

The treatment of fibrinous pleurisy is directed to the elimination of the underlying cause Symptomatic relief is afforded by immobilization using a chest binder or adhesive plaster

Pleurisy with Effusion.—*Small and inconsequential* pleural effusions often occur in the course of lobar pneumonia acute pneumonitis pulmonary infarction and as a reaction to inflammatory disturbances of the liver (sympathetic effusion) In most of these examples the clinical manifestations are insignificant and the diagnosis becomes apparent only from the roentgenological appearance



Fig 511—Roentgenogram of chest with pleural effusion

Massive pleural effusions are most often of hematogenous origin They usually occur in adolescents and young adults and almost without exception are due to tuberculosis The onset of symptoms is usually abrupt as in an acute fibrinous pleurisy In a few days chest pain disappears but the physical signs of fluid become manifest The relief from pain is presumably due to separation of the inflamed visceral and parietal surfaces with splinting of the chest wall The phase of symptomatic relief may be associated with marked constitutional reactions which include weakness sweating malaise fever dyspnea cyanosis and chilliness

Less often the onset of a serous effusion is insidious The patient complains only of feverishness and weakness Despite the presence of several liters of pleural fluid there may be no localizing symptoms and no appreciable respiratory distress

Wilson in Pullen Medical Diagnosis

few organisms Since the pleural fluids in *rheumatic fever* and *disseminated lupus erythematosus* are also free from organisms the mechanism of hypersensitivity may be operative

Bacteriology—In a dry or serous pleurisy bacteria are rarely demonstrable in appreciable numbers unless the stage of empyema is impending So called idiopathic pleural effusion with few and inconsequential manifestations of underlying pulmonary disease is most often *tuberculous* (p 63) The causative organism is rarely demonstrable in stains and smears but inoculation of the fluid into guinea pigs reveals the etiology of the affliction

Bacteria are readily demonstrable in empyema fluid The common invading organisms are pneumococcus staphylococcus streptococcus and *B mucosus capsulatus*

CLINICAL MANIFESTATIONS

The clinical manifestations of pleuritis are dependent upon the nature of the exudate

Acute Fibrinous Pleuritis—Acute fibrinous pleuritis usually has a *sudden onset* with localized *chest pain* (p 2080) The typical response to a dry pleurisy is localized lancinating pain aggravated by motions of the body coughing and deep breathing but relieved by any position which splints the pleura and sets it at rest Most frequently the patient lies on the affected side with arms pressed over the chest in a conscious effort to restrict activity The onset of pleural pain is usually associated with chilliness or a frank chill followed by increase in the constitutional manifestations of the underlying complaint

Since the parietal pleura alone is sensitive and its involvement produces referred pain along the somatic distribution of the segmental intercostal nerve *deceptive radiations* are occasionally encountered The pain may be described as axillary or subscapular it may radiate to the shoulder neck right or left hypochondrium Thus a fibrinous pleurisy may simulate *anginal pain* (p 891) *coronary occlusion* (p 983) *gallbladder colic* (p 2000) *acute appendicitis* (p 1881), *splenic infarction* (p 1130) or *arthritis* of the *shoulder* Fortunately the confusion is soon clarified by the results of the physical examination

Diaphragmatic Pleurisy—Involvement of the diaphragmatic pleura produces bizarre radiations of pain The central leaf of the diaphragm is innervated by the phrenic inflammations result in pain that is referred to the shoulder The periphery of the diaphragm is innervated by the lower six thoracic nerves radiations in this area result in pain that is referred to the abdominal wall simulating acute cholecystitis acute appendicitis coronary thrombosis or penetraton of a peptic ulcer

Physical Examination—The pathognomonic sign of a fibrinous pleurisy is the presence of the *friction rub* that is heard over the involved pleural surfaces It is increased by pressure of the tethoscope and is often palpable as well as audible *Pleuropericardial rubs* are noted when the pleura adjacent to the pericardium is involved, unlike pericardial friction rubs pleuropericardial sounds are intensified by respiratory movement and diminished with voluntary holding of the breath

Course and Treatment—The course of a fibrinous pleurisy depends on the etiology of the underlying process There may be complete resolution

symptoms persist beyond the expectancy or when there is a recurrence of fever leukocytosis and chest pain after the pneumonitis has apparently resolved

Chronic Empyema—Chronic empyema is apt to result from the neglect in managing an acute suppurative invasion It also follows retention of foreign bodies such as sponges rubber tubing or gauze packing osteomyelitis of the adjacent rib infection with tubercle bacilli actinomyces and other rare pulmonary invaders

Putrid Empyema—The sudden onset of a putrid pyo-pneumothorax indicates the rupture of a putrid lung abscess (p 2215) The symptoms are urgent requiring immediate surgical intervention with underwater drainage and intensive systemic anti infective therapy with sulfonamide (p 88) and/or penicillin (p 106)

Physical Examination—The physical signs of empyema are variable and often are obscured by the underlying pulmonary involvement Roentgenograms are mandatory for the detection of small empyemas and for localization Proof of the presence of the suppurative process is at hand when diagnostic aspiration is performed Smears usually reveal the morphological character of the invading organism many polymorphonuclear leukocytes are present and cultures confirm the identity of the invading micro-organisms

Treatment—The suggestion of an empyema requires consultation with the attending surgeon Therapy with anti infective agents (p 106) has done much to prevent and alleviate purulent pleuritis but the demonstration of frank pus in an encapsulated area calls for *surgical drainage* by *thoracotomy* with or without rib resection Following operation or thoracentesis the cavity should be lavaged with a solution of penicillin (1 cc = 2 000 to 10 000 units) Open drainage in the presence of thin pus lying free in the general pleural cavity invites mediastinal flutter which may prove fatal Operation is best deferred until a thick walled cavity is demonstrable

CHRONIC PLEURITIS

Chronic pleuritis rarely presents any clinical manifestations Adhesions are formed in almost all of the acute pulmonary infections and in all of the chronic manifestations of pneumonitis (p 2202) Physical signs are rarely produced mechanical disturbances are not encountered unless the adhesions cover the entire pulmonary surfaces The condition is of moment only when attempts are made to produce an *artificial pneumothorax* in the course of chronic tuberculous pneumonitis (p 2199)

ACUTE MEDIASTINITIS

Inflammation of the mediastinum is almost always secondary to infection elsewhere The primary lesion may be a peritonsillar or cervical abscess a lingual or faucial tonsillitis pneumonitis tracheitis pleuritis osteomyelitis of the ribs perforation of the esophagus or trachea mediastinal lymphadenitis or pericarditis

Clinical Manifestations—The symptoms of acute mediastinitis are indefinite chills fever and prostration occur but offer no help in localization of the infection *Acute mediastinal* suppuration or abscess is generally not localized or encapsulated because of the anatomical peculiarities

Physical Examination—The physical signs of a large pleural effusion are characteristic and easily recognized The affected side appears fuller and more rounded there is a definite lag of the movement of the *ipsilateral chest wall* during the respiratory cycle *mediastinum trachea* and *apex impulse* are displaced away from the affected side the *percussion note* is flat a sense of increased resistance is imparted to the percussing fingers *breath sounds* are distant or absent the *upper limit of fluid* is marked by an S shaped curve of flatness whose apex is in the posterior axillary line Just above the upper border of dulness there is an area of *increased resonance* with rales and egophony Frequently a triangular area of dulness is noted at the base of the uninvolved lung posteriorly (*Grocco s triangle*) With roentgenographic control it becomes apparent that physical signs are not audible until 250 to 500 cc of pleural fluid have accumulated in the cavity

The Pleural Fluid—The diagnosis of an effusive pleurisy is confirmed by aspiration of the pleural fluid which is then examined cytologically by carbolfuchsin stain and guinea pig inoculation In a tuberculous effusion the fluid is pale in color with the specific gravity of 1 016 or more The protein content is high and often exceeds 4 per cent, clotting occurs at room temperature within a short time due to the high percentage of fibrin and the cell count varies from 1000 to 5000 per cu mm The majority of cells are lymphocytes with only a minority of leukocytes small numbers of erythrocytes are present but grossly bloody fluid does not ordinarily occur Acid fast bacilli are rarely demonstrable in smears but *guinea pig inoculation* attests to the etiology of the disturbance (p 63)

Course and Treatment—The course of the tuberculous pleural effusion is variable In favorable instances the fluid slowly reabsorbs with a gradual defervescence In the less favorable instances the fluid continues to accumulate to the point of causing respiratory embarrassment Healing is followed by the formation of dense pleural adhesions

While diagnostic thoracentesis is mandatory removal of the fluid for therapeutic purposes is unwise unless there are evidences of respiratory embarrassment The clinical reaction is undoubtedly of protective value to the parenchymal tuberculous lesion and serves the same purpose as the deliberately induced *artificial pneumothorax* (p 2035) The favorable course of tuberculosis in most patients who develop effusion testifies to the possibility that the pleural reaction is of some immunotherapeutic utility Before removal of fluid however the practitioner does well to obtain the opinion of an expert in pulmonary disease

Empyema Thoracis—Empyema thoracis usually is secondary to pulmonary disease although it may also follow penetrating wounds of the chest wall On rare occasions it is a manifestation of a hematogenous infection Empyema develops most frequently during the course of a pneumococcal lobar pneumonia it may also be of streptococcal or staphylococcal origin and is produced disproportionately frequently by the *Bacillus mucosus capsulatus*

Para and Postpneumonic Empyema—In the acute phases of pneumonia or pneumonitis the manifestations of empyema (*parapneumonic empyema*) are overshadowed by pulmonary symptoms *Postpneumonic empyema* becomes apparent as a complication when the constitutional

SECTION XIV

THE URINARY SYSTEM

Associate Editors MOSES SWICK M D

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of the mediastinal space Substernal pain interference with the venous return to the heart obstruction to the thoracic duct or involvement of the autonomic nerves in the region may suggest the site of the involved area Careful *roentgenographic examination* is necessary for correct anatomical diagnosis A lateral film taken while barium is being swallowed may reveal displacement of the esophagus or enlargement of the posterior mediastinum

Prognosis and Treatment—The prognosis of acute suppurative mediastinitis is grave Occasionally the abscess may evacuate itself through the trachea neck or intercostal spaces *Surgical drainage* because of the location of the lesion is hazardous and accompanied by a high mortality Greatest reliance is placed in systemic anti infective therapy using both sulfonamide (p 88) and penicillin (p 106)

CHRONIC MEDIASTINITIS

Chronic mediastinitis may result from untreated acute mediastinitis more often it is of the indurative type producing a *mediastinopericarditis* The common etiologic factors are *syphilis* and *tuberculosis* The latter may involve all the mediastinal structures especially the pericardium

The symptoms of chronic indurative mediastinitis usually develop slowly as the result of obstruction of the superior and inferior vena cava the thoracic duct and the autonomic nerves *Roentgenography* may reveal widening of the mediastinal shadow

Treatment depends upon the etiology In the case of tuberculosis and idiopathic Pick s syndrome there is no satisfactory specific treatment

CHAPTER 100

GENERAL METHODS OF DIAGNOSIS AND TREATMENT

The urinary system functions for the formation and excretion of urine and additionally may furnish internal secretory agents which influence arterial tonus The secretory mechanism of the urinary system is located in the cortex of the kidney The excretory mechanism consists of uriniferous tubules the renal pelvis the ureters and urinary bladder and the urethra through whose meatus the specimen eventually is passed

ANATOMY

The Kidneys—The kidneys are situated in the posterior part of the abdomen one on each side of the vertebral column and are retroperitoneal and surrounded by a mass of fat and loose areolar tissue Their *upper extremities* are on a level with the upper borders of the twelfth thoracic vertebra the *lower extremities* on a level with the third lumbar vertebra The *inferior poles* are directed a little outward as well as forward The left inferior extremity under normal circumstances cannot be felt Because of the proximity of the liver the right kidney is usually on a slightly lower level than the left In the female both kidneys are a little lower than in the male

Each kidney is approximately 4½ inches long 2½ inches wide and about 1½ inches thick The kidney of the male usually weighs 150 to 170 gm that of the female 115 to 155 gm

The *external borders* of the kidneys are convex The *internal borders* are concave and present a deep longitudinal fissure—the *hilum* or *sinus renalis*—through which the vessels nerves and ureters pass At the hilum the relative position of the main structures are veins in front arteries in the middle and ureters behind and somewhat below

The *mesial and superior surface* of each kidney is covered by the corresponding adrenal gland The *anterior surface* of each kidney is contiguous with intraperitoneal structures Thus the right kidney is covered by liver duodenum and hepatic colon the left kidney by spleen stomach *pancreas* jejunum and splenic colon

Posteriorly the upper poles of the kidneys impinge upon the corresponding areas of the diaphragm elsewhere they are covered by the posterior spinal muscles It is in this position that the kidneys are vulnerable to trauma Penetrating wounds may perforate the organ blows by impact may cause rupture of the viscus

The kidneys are imbedded in a mass of fatty tissue termed the *perirenal fat* Extension of infection from the renal cortex produces perinephritis The kidneys and the perirenal fat are enclosed in a sheath of fibrous tissue contiguous with the subperitoneal fascia This fibro-elastic membrane is solid and tenacious Normally the capsule is loosely connected to the kidney and may readily be stripped away (decapsulation) It persists when the organ is destroyed by infection It may constrict the viscus when there has been an acute swelling or congestion of the parenchyma In inflammatory conditions it becomes thickened and adherent

The cut surface of the kidney reveals that it is readily divisible into an outer third the cortex and the inner two thirds the medulla

The *cortex* is reddish brown soft and granular in consistency It lies immediately beneath the capsule and arches over the bases of the pyramids to dip in the form of columns toward the renal hilum between adjacent pyramids The cortex consists of a series of lighter colored raylike prolongations of straight tubules from the medulla (the medullary rays) and a darker colored intervening substance (the labyrinth) The labyrinth contains the convoluted portions of the uriniferous tubules and the glomeruli

The *medulla* consists of reddish striated pyramids The apex of each pyramid is known

branches each of which forms a capillary plexus The blood from each plexus is collected by a small branch which joins with its fellows to form the *efferent arterioles* The various plexuses constitute a *glomerulus* or *malpighian corpuscle* On leaving the glomerulus the arterioles form a capillary network around the adjacent portion of the uriniferous tubules. The blood is then collected by various channels which eventually unite to form the *renal veins* These enter the inferior vena cava, the left renal vein passing anterior to the aorta

The *nerves* of the kidney are derived from the renal plexus which is formed by branches of the solar plexus the lower and outer part of the semilunar ganglion and the aortic plexus Branches also arise from the lesser and smaller splanchnic nerve These communicate with the spermatic plexus—a circumstance which may explain the occurrence of testicular pain in affections of the kidney Both adrenergic and cholinergic innervations are represented The former are of clinical significance in functional hypertension Surgical procedures by interruption of nerve fibers are used for the relief of hypertension (p 914)

Bladder and Ureters.—See p 2245
Male Urethra—See p 2393
Female Urethra—See p 2643.

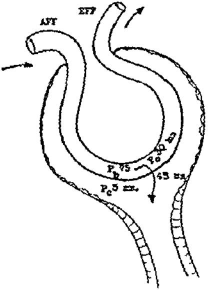


Fig 513—Diagram illustrating the relation of blood pressure (P_b) osmotic pressure (P_o) and capsular pressure (P) upon the formation of urine Aff = afferent arteriole, Eff = efferent arteriole

PHYSIOLOGY

The successful functioning of the urinary system requires urine formation and excretion The physiology of the elaboration of urine and of micturition require review for intelligent comprehension of abnormalities

The Formation of Urine.—The elaboration of urine is the chief function of the nephron, the renal anatomical unit The process involves glomerular filtration and tubular reabsorption.

The Renal Circulation—The mechanism of urine formation is suggested by certain peculiar anatomical features of renal circulation (Fig 512)

1 The *renal artery is short*, arises directly from the aorta and breaks up quite suddenly into short branches this arrangement insures the delivery of blood under a *high head of pressure* to glomerular vessels

Best, C H and Taylor N B The Physiological Basis of Medical Practice 3rd ed Baltimore, The Williams and Wilkins Co 1940

as the *renal papilla* Each papilla shows upon its apex a number of *minute orifices of the* excretory ducts of the pyramids

The minute structure of the *nephron* the unit of the urinary system consists of a *glomerulus* or renal corpuscle (*malpighian body*) (see blood supply) and the *convoluted* and *collecting tubules* which terminate in the *papillary* or *excretory ducts* of the *renal papilla* These empty into the *calices* and then into the renal pelvis and the ureters

The blood supply of the kidney is carried by the *renal artery* a large branch of the *abdominal aorta* *The importance of the kidney as an excretory organ is suggested by the* fact that this artery is many times larger than is necessary for the nutrition of an organ of the size of the kidney Prior to entering the kidney the artery divides into four or five branches which are then distributed to the renal substance Each vessel gives off small branches to the adrenal gland the ureters and the surrounding tissues and muscles

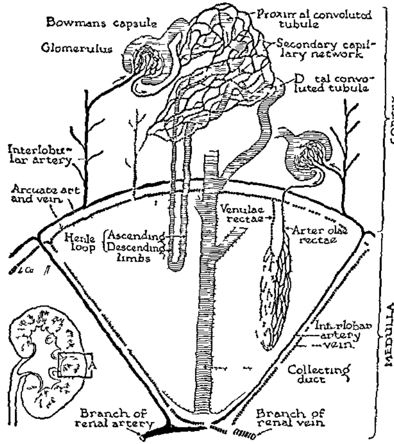


Fig 512 —Diagram of a renal tubule Inset *A* shows the location of the renal tubule in the kidney

The branches of the renal artery that pass into the kidney are situated between the pyramids and are known as the *interlobar arteries* At the junction of the cortical and medullary portions the interlobar arteries turn and for a short distance pursue a course parallel to the kidney surface They form a series of incomplete vascular arches known as the *arcuate arteries* From these a group of vessels passes to the periphery and enters the cortex as the *cortical arteries* Others pass towards the sinus and enter the medulla as the *arteriolae recti*

The cortical or intralobular arteries give off branches to each renal corpuscle These are the *afferent arterioles* As each arteriole enters the corpuscle, it divides into several

* Millard and King Human Anatomy and Physiology

urea) concentrate in urine in direct proportion to their concentration in the blood, so that indices may be calculated for determining renal function

Tubular Reabsorption and Voided Urine.—Glomerular urine and voided urine differ greatly in composition due to the interposition of the factor of tubular reabsorption The reabsorbed fluid is of constant composition and resembles *Locke's solution* containing sodium, calcium potassium, magnesium chloride dextrose and small quantities of urea uric acid and phosphate The remainder of the fluid is excreted as urine

DIFFERENTIAL DIAGNOSIS OF

Polyuria

Polyuria is the condition in which the patient passes an abnormally large quantity of urine It is differentiated from frequency (p 2310) in which voiding occurs at short intervals without necessary increase in the total daily output.

Related conditions include nocturia in which the nightly output is excessive and approximates or exceeds the daily quantity nycturia in which there are frequent night voidings but not necessarily an increase in quantity and hyposthenuria in which the specific gravity of the urine is fixed usually at a level below 1 010 Hyposthenuria is usually associated with nocturia The combination is indicative of marked decrease in the functional efficiency of the kidney In order adequately to excrete the patient is compelled to void frequently in large quantities, by day and night. He requires, as it were a night shift in order to clear the tissues of excretory products Whereas nocturia and hyposthenuria are manifestations closely allied to renal function, polyuria more often is of extrarenal origin

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	Emotional In hysteria
Pharmacodynamic	Following the use of diuretics With corrective doses of thyroid extract in myxedema
Alimentary	From forcing of fluids During alcoholic spree especially after the ingestion of beer or gin
Metabolic	Relief of edema Diabetes insipidus with polydypsia passage of urine of low specific gravity and therapeutic response to pitressin Diabetes mellitus with glycosuria and hyperglycemia Amyloidosis with hepatosplenomegaly and positive Congo-red test (p 7) Acromegaly with bone changes and defects of sella turcica
Renal	Relief of intermittent hydronephrosis in Dietl's crises (p 2295) Polycystic kidneys with bilateral enlargement and hypertension (p 2291) Chronic glomerulonephritis with nocturia hyposthenuria azotemia and disturbances in concentration and dilution tests (p 2379) Correction of hypoproteinemia as in nephrosis (p 2389)
Neurogenic	Following attacks of migraine or epilepsy

The composition of voided urine is determined by the effects of a wide variety of physiochemical processes which include the composition of blood peripheral arterial pressure, the minute-volume of glomerular blood flow differential pressures between efferent and afferent glomerular loops the integrity and permeability of filtering membranes in Bowman's capsules the amount of reabsorption in the tubules the amount and degree of back pressure in the urinary collecting system and the head of venous pressure See *Renal Function Tests of* (p 2240) *Renal Insufficiency* (p 2275) *Renal Ischemia* (p 2273) *Urine Abnormalities of* (p 3684)

2 The *renal artery* is very *large* in proportion to the bulk of tissue which it supplies providing a *large volume flow* which must pass first through *glomerular tufts*

3 The *afferent arteriole* of the glomerular tuft is approximately double the diameter of the *efferent vessel* so that there must be a high head of pressure in the *glomerular plexus* In this plexus each capillary loop is enveloped in a prolongation of the visceral layer of Bowman s capsule so that capillary blood and its filtrate of glomerular urine are separated by two membranes which together have a thickness of only 1 micron

DIFFERENTIAL DIAGNOSIS OF

Enlargements of the Kidney

Enlargements of the kidney are easily demonstrable Most often the nature of the disturbance is delineated by intravenous and retrograde urography cystoscopy ureteral catheterization, urinalyses and tests of renal function Only in rare instances does operation disclose unforeseen findings to the practitioner who has had the advantage of a complete survey

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital	Unilateral hyperplastic kidney (p 2287) Congenital hydronephrosis or polycystic kid neys (p 2291) latter usually associated with hypertension. Obtain intravenous urograms before attempting retrograde pyelography (p 2248)
Mechanical	Nephroptosis with increased motility and history of intermittent hydronephrosis (p 2293) Hydronephrosis with increased capacity of renal pelvis but no evidences of infection (p 2295) Perirenal hematoma after injury (p 2330)
Metabolic	Calculosis Note radiopaque shadows (p 2314) If not demonstrable catheterize ureters (p 2248)
Infectious and Inflammatory	Renal carbuncle furuncle or tuberculosis Pyonephrosis or pyelonephritis Note pyrexia pyuria and costovertebral tenderness Deformities demonstrable by intravenous and retro grade urography (p 2248) Attempt anti infective therapy in nontuberculous infections (p 106) Prepare for nephrectomy in the case of acid fast organi ms (p 2347) Echinococcus cysts with po itive skin test and eosinophilia
Neoplastic	Malignancies particularly in infancy (Wilm s tumor) Note deformities of calyces and per sistent painle s hematuria (p 2326) Serous cysts with normal preoperative findings

4 The *tubules* are supplied entirely by blood which has first passed through the *glomeruli* Thus as in the portal circulation there are two sets of capillaries to be traversed before blood enters a vein

The Renal Filter and Glomerular Urine—The pressure relationships within the glomerular tufts indicate that this part of the kidney acts as a filter though the function is selective and not purely mechanical *Glomerular* urine differs strikingly in composition from plasma Certain *high threshold substances* (dextrose amino-acid and sodium chloride and bicarbonate) are held in the circulating fluid and do not appear in urine until a h gh concentration has been reached. The *low threshold group* of chemicals (creatinine urate and

Micturition.—The passage of the final urine from the collecting tubules to the external urethral meatus is a complicated process The urinary tract is provided with ducts a reservoir and valves which prevent the uninterrupted continuous flow of urine from the renal pelvis to the urethral opening These "block mechanisms" assure coordinate functioning of the various portions of the system and prevent the retrograde flow of urine from the lower portions of the tract to the kidneys

The Mechanics of Micturition—Only the flow of urine from the tubules to the renal pelvis is a continuous process In the ureters, peristaltic activity at a rate of 1 to 5 waves per minute, causes the urine to spurt into the vesical lumen. As the bladder fills there is a gradual increase in *intravesical pressure* When a set level of pressure is attained rhythmical contractions of the bladder muscle are initiated and these give rise to the desire to urinate *If unheeded the threshold tension level is set at a higher level* by voluntary control until the micturition reflex finally is heeded

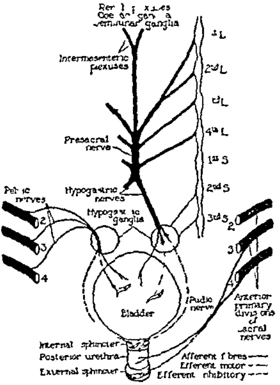


Fig 514 —Innervation of the bladder

The *act of micturition whether reflex or voluntary consists of strong sustained contraction* of the detrusor muscle and simultaneous relaxation of the internal sphincter so that urine is expelled with considerable force Retrograde flow of urine from bladder into ureters is prevented by vesico ureteral valves which are formed by the compression of the vesical musculature on the lower ends of the ureters The reservoir function of the bladder is maintained by the vesical sphincter a condensation of circular muscle fibers around the internal urethral opening In the male the membranous portion of the urethra is surrounded by the striated external sphincter

Nervous Control of Micturition—The neurogenic control of micturition involves renal, ureteral and vesical fibers controlled by ganglionic spinal subcortical and cortical way-stations under combined voluntary and involuntary influences

After Learmouth Mayo Clinic

DIFFERENTIAL DIAGNOSIS OF

Oliguria and Anuria

Oliguria is a state in which the urinary output falls appreciably: in anuria there is suppression of urine secretion Both conditions must be differentiated from retention of urine a manifestation unrelated to renal function (p 2240)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	Emotional In hysteria
Neurogenic	Reflex with calculus disease intestinal obstruction and general peritonitis
Alimentary	Starvation and limitation of fluid intake
Metabolic	Loss of fluid through extrarenal channels as in fever insolation, sweating vomiting diarrhea hemolysis hemorrhage drainage through stomach or intestinal tubes, acute dilatation of stomach intestinal obstruction or seepage through a fistula During accumulations of edema hydrothorax or ascites Myxedema with low B M.R Note therapeutic response to thyroid extract. Overdosage with adrenal cortical extract. Cholemia associated with hepatitis as in acute yellow atrophy or yellow fever
Pharmacodynamic	Poisoning with mercurials sulfonamides and arsenicals Corroborate history with urine examinations
Circulatory	Forward failure with shock Particularly note therapeutic effect of plasma infusions (p 3778) Backward failure with congestion and edema Consider digitalization and use of diuretics (p 2257)
Obstetric	Hypertensive toxemia of pregnancy with albuminuria and elevation of blood pressure Bilateral cortical necrosis in pregnancy
Renal	Congenital anomalies such as absent or imperforate urethra Following instrumentation of the urinary tract Obstructive uropathies best delineated by urethroscopy cystoscopy and retrograde pyelography (p 2251) Injuries to penis bladder or kidneys Accidental ligation of ureters during surgical procedures Obstruction of renal artery with lumbar pain and hematuria As reflex to renal colic from unilateral calculus disease Parenchymatous nephritis with albuminuria cylindruria and normal functional tests Tubular nephrosis due to blockage particularly from sulfonamide crystals Tubular nephritis due to mercurial poisoning or alkalosis Acute glomerulonephritis with albuminuria cylindruria and hematuria Nephrotic syndromes with albuminuria cylindruria hypoproteinemia and hypercholesterinemia

Rectal Examination (p 3639)
Prostatitis (p 2470) *Prostatic Hypertrophy* (p 2445) and *Neoplasms* (p 2322)
Vaginal Examination (p 3646)
Urethritis (p 2336) *Cystocele* (p 2537)
Instrumentation of Urethra (p 2254)
Urethral Strictures (p 2299)
Catheterization of Urinary Bladder (p 2236)
Retention of Urine (p 2264) *Cystitis* (p 2342)



Fig 515.—First step in the passage of urethral instruments with rigid fixed curves (sounds, natural curve and exaggerated curve French catheters etc) See Figs 516 517 518 *

Catheterization—*Catheterization* of the female is accomplished by means of a metal or glass catheter sterilized by boiling The meatus of the urethra is *thoroughly washed with a 1 1000 bichloride of mercury solution* The catheter is lubricated throughout its length with a sterile greaseless lubricating jelly The catheter is then gently introduced into the bladder

* Herman The Practice of Urology

THE KIDNEY —The kidney is richly supplied with autonomic nerves most of which are adrenergic fibers arising from the sixth thoracic to the third lumbar segments These convey vasoconstrictor and vasodilator impulses to the renal arterioles and the capillaries of glomeruli and tubules They regulate renal blood flow and may under the influence of pain cause a reflex vasoconstriction resulting in anuria The kidney receives also cholinergic innervation from the vagus

THE URETERS —The ureters have adrenergic motor fibers which derive from the renal and spermatic or ovarian plexus and the hypogastric nerves The existence of a separate *cholinergic* innervation has not been demonstrated

THE BLADDER —The bladder is supplied with adrenergic nerves from the lumbar segments of the cord Cholinergic fibers arise from the sacral segments and are conveyed in the pelvic nerve Somatic elements are derived from the sacral segments (pudic nerves) The adrenergic nerves control the involuntary mechanism of the filling of the bladder They cause relaxation of the detrusor muscle and contraction of the internal sphincter The somatic nerves serve in the voluntary control of micturition and supply the external sphincter the urethra and the accessory urethral and perineal muscles

COORDINATION OF MICTURITION —The control of micturition resides in five nervous centers (*1*) cerebral (2) subcortical (*3*) lumbar (4) sacral and (5) ganglionic

The micturition impulse normally originates in the higher cerebral centers It is relayed subcortically by the midbrain to the spinal centers Inhibitory impulses to the detrusor and stimulator impulses to the internal sphincter pass out via the hypogastric nerve whereas antagonistic impulses emanate by way of the pelvic nerve In the normal individual the autonomic divisions are in a state of balance and the complicated function of micturition is accomplished with ease

NEPHROPATHIES AND UROPATHIES

The disturbances of the urinary system consist of (1) disorders of the *nephrons* or renal functional units (2) abnormalities of the *excretory duct system* and (3) derangements of the *hormonal effects* relative to vascular tension The *nephropathies* which constitute the first group are conventionally the concern of the internist while the *uropathies* or excretory disorders are included in the field of urology This artificial distinction has evolved from technical considerations and has limited the scope of management and therapy Due to increasing awareness of the significance of kidney function in urologic problems and of uropathies in nephritis the present material minimizes the line of division between medical and surgical affections of the urinary tract

METHODS OF DIAGNOSIS

The diagnosis of urologic disease requires the cooperation of practitioner laboratory and specialist

EXAMINATIONS BY THE PRACTITIONER AND THEIR INDICATIONS

Inspection of Urethral Meatus (p 3646)
Disturbances of Micturition (p 2264), *Urethral Discharge* (p 2340)

Palpation of Urethra (p 3646)
Urethritis (p 2336) *Urethral Stricture* (p 2299)

Percussion of Hypogastrium
Retention of Urine (p 2264)

Palpation of Lower Poles of Kidneys
Nephroptosis (p 2293) *Neoplasms of Kidney* (p 2326), *Enlargements of Kidney* (p 2230)

Inspection and Palpation of Lumbar Regions and Costovertebral Angles
Perinephritis (p 2359) *Neoplasms of Kidneys* (p 2326)

bladder sphincter is felt against the catheter it is better to wait patiently for spasm to relax than to attempt to force a passage If there is any difficulty in entering the bladder with the soft rubber catheter or if there is any suspicion that the urethra is distorted by stricture or pressure from an enlarged prostate the hard rubber woven elastic bougie catheter should be employed This catheter must be sterilized by bichloride of mercury solution and must never be boiled Lubrication is of the greatest importance and the procedure is best attempted in introducing the catheter with the penis extended to its greatest length in a position over the left anterior

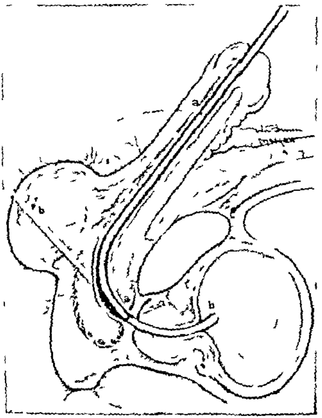


Fig 517—Third step in the passage of sounds See Figs 515 516 518

superior spine When the bladder sphincter is felt the penis is then rotated in an arc until it approaches the right anterior superior spine Somewhere in this arc the sphincter will relax and the bladder will be easily entered

There are three types of catheters to be employed in the male These are made of soft rubber silk elastic woven material and latex The *soft rubber catheters* are of the straight variety (Nelaton) or the angled olive beaked tip (Tiemann) type and are particularly useful in instances where there is obstruction from a hypertrophied prostate The rubber catheters may be sterilized by boiling The *elastic silk woven types* of catheter are

After the urine has been withdrawn bladder irrigation may be performed by connecting the catheter to a reservoir containing sterile saline

Catheterization of the male is usually associated with a certain amount of discomfort or pain It is advisable to anesthetize the mucous membrane before conducting any endo urethral manipulation The use of 20 to 30 cc of 1 500 nupercaine or 2 per cent metycaine is recommended The injection of the local anesthetic is carried out with a urethral syringe and the solution prevented from escaping by applying a urethral clamp for about five minutes while the posterior urethra is gently massaged

The first catheterization in any male patient should never be left to an orderly or male nurse As a matter of convenience it may be necessary to

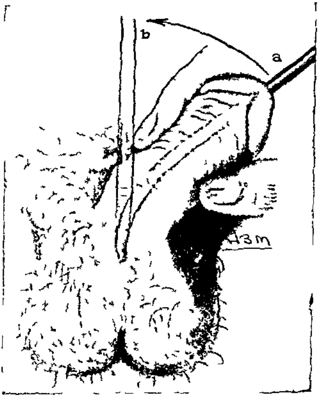


Fig 516—Second step in the passage of sounds See Figs 515 517 518

leave routine catheterization at a later time to the attendant but this should be avoided wherever possible Self catheterization is to be condemned for infection and urinary fevers will surely follow If the practitioner cannot readily and gently catheterize the male patient with the simple soft rubber catheter or the ordinary elastic bougie type it is far wiser to summon an urologist than hazard further trauma and possibly produce a false passage or infection

The mouth of the urethra is washed thoroughly with bichloride of mercury solution (1 1000) The meatus is lubricated as well as the catheter The greatest gentleness must be employed in this technic When the

* Herman The Practice of Urology

bladder sphincter is felt against the catheter it is better to wait patiently for spasm to relax than to attempt to force a passage If there is any difficulty *in entering the bladder with the soft rubber catheter or if there is* any suspicion that the urethra is distorted by stricture or pressure from an enlarged prostate the hard rubber woven elastic bougie catheter should be employed This catheter must be sterilized by bichloride of mercury solution and must never be boiled Lubrication is of the greatest importance and the procedure is best attempted in introducing the catheter with the penis extended to its greatest length in a position over the left anterior

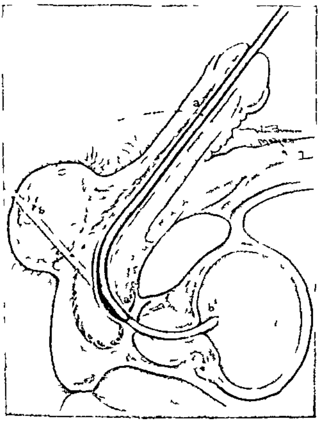


Fig 17—Third step in the passage of sounds See Figs 515 516 518

superior spine When the bladder sphincter is felt the penis is then rotated in an arc until it approaches the right anterior superior spine Somewhere in this arc the sphincter will relax and the bladder will be easily entered

There are three types of catheters to be employed in the male These are made of soft rubber silk elastic woven material and latex The *soft rubber catheters* are of the straight variety (Nelaton) or the angled olive beaked tip (Tiemann) type and are particularly useful in instances where there is obstruction from a hypertrophied prostate The rubber catheters may be sterilized by boiling The *elastic silk woven types* of catheter are

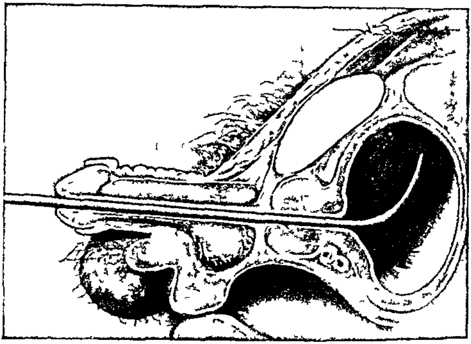


Fig 518—Fourth step in the passage of sounds (See also Figs 515 516 517) Details are described in text *

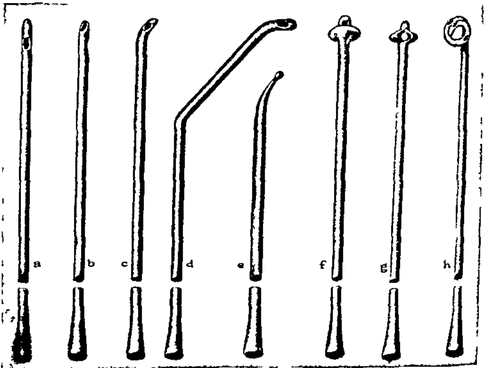


Fig 519—Soft rubber urethral catheters *A* Straight, closed tip catheter *B* whistle tip *C* coudé *D* bicoude *E* coude with olive tip *F* button self retaining de Pezzer catheter *G* Malecot (4-wing) catheter self retaining; *H* pig tail self retaining catheter *

* Herman, The Practice of Urology

destroyed by boiling and must be sterilized by immersion in 1 3000 oxy cyanide of mercury for one half hour These catheters may be of the straight cylindrical variety either conical or olive tipped the beaked angled type with cylindrical or olive tip (Mercier curved) the double elbow variety (bicoude) particularly useful in instances of hypertrophy of the prostate gland the open end catheter the filiform catheter particularly useful in strictures of the urethra and the conical catheter fitted with a terminal filiform bougie

Where there is obstruction in the urethra the silk elastic catheter may be strengthened by the use of a mandrin Under these circumstances

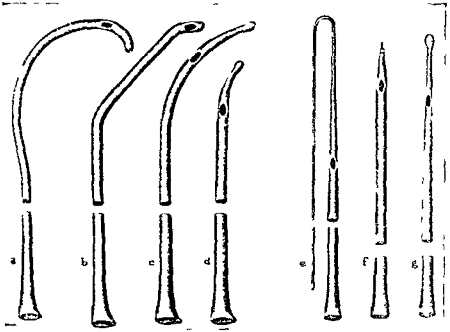


Fig 520—Woven (Mercier or French) catheters *A* Exaggerated or prostatic curve *B* bicoude *C* natural curve *D* coude (olive tip) *E* rat tail *F* woven catheter threaded for filiform (flexible guide) *this and the preceding type are commonly called Banks or* Phillips catheters *G* tapered olive tip catheter

more than usual care and gentleness must be observed lest trauma and a false passage result *Metal* catheters have been virtually abandoned because of their danger

Induelling catheters are kept in place by means of four strips of adhesive running from the shaft of the penis onto the catheter These longitudinal strips are reinforced by circumferential strips wrapped around the penis

Sterilization of Catheters—Soft rubber and metal catheters can be boiled together with forceps Silk woven catheters must be sterilized either by means of formalin vapor or in 1 3000 oxycyanide of mercury for one half hour

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LABORATORY EXAMINATIONS AND THEIR INDICATIONS

Urine Analysis (p 3667)
Routine
Urine, Bacteriology (p 3690)
Infections (p 2334)
Urethral Discharge (p 2340), Spread and Culture (p 50)
Gonorrhea (p 2338), *Nonspecific Urethritis* (p 2336)
Vaginal Discharge, Direct Microscopy, Spread and Culture
Trichomonas Vaginalis (p 2598) *Gonorrhea* (p 2586)
Ureteral Specimens (p 2250), Microscopy, Carbolfuchsin Stain (p 50) Guinea Pig Injection
Calculus Disease (p 2311), *Renal and Pelvic Infections and Tuberculosis* (p 2347) *Kidney Neoplasms* (p 2326)
Chemical Analysis of Calculus (p 2312)
Nephrolithiasis (p 2314)
Tests of Kidney Function (p 2240)
Routine



Fig 521 —Flexible mandrin at times used for the introduction of the rubber urethral catheter It can be bent into any shape *

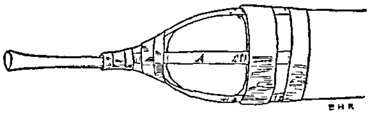


Fig 522 —Diagram showing the method of retaining a catheter in the urethra by means of adhesive plaster

Blood Chemistry (p 3712), Urea, Urea Nitrogen, Uric Acid (p 3713) Free and Conjugated Phenols (p 2280) Electrolyte Pattern (p 5)
Renal Insufficiency (p 2275), *Calculus Disease* (p 2311) *Acidosis* (p 721)
Biopsy
Renal Tuberculosis (p 2347) *Neoplasms* (p 2322)

URINARY TESTS FOR RENAL FUNCTION (OFFICE LABORATORY)

The function of the kidney can be estimated accurately and with great ease The data furnish an index of the gravity and course of renal disease and logically complement the results of the routine urine analysis The methods used to determine the functional capacity of the kidneys are all based on one of two general aspects of renal activity (1) the concen

* Pelouze Office Urology

tration and dilution power of the kidney (2) the ability of the kidney to excrete metabolites or foreign substances (phenolsulfonphthalein)

Although the number of tests that have been introduced is legion only three are commonly used (1) the *concentration* test (2) the *dilution* test and (3) the *phenolsulfonphthalein* test The concentration and dilution tests are the simplest and by far the most useful For most purposes they are the only renal function tests with which the practitioner need concern himself The only apparatus required are a graduated cylinder and a hydrometer

The Concentration Test—The concentration test measures the ability of the kidney to reabsorb water and excrete solids as indicated by the maximum specific gravity of the urine after a moderate period of fluid deprivation

Technic—The patient is instructed to drink nothing after his usual lunch on the day before the test The evening meal should be complete but should be taken without fluid The bladder is emptied before retiring and this voiding as well as all others during the night are discarded

In the morning the first voided urine is kept in a separate bottle Breakfast and fluids are withheld until the test is complete At the end of each one hour period for three hours after the first morning voiding the bladder is emptied and the urine is kept in a separate bottle Each bottle is labeled with the time when the specimen was obtained The only examinations required are the measurements of volume and the estimation of *specific gravity* (p 2242)

Results—If renal function is unimpaired the specific gravity of at least one specimen will exceed 1 022 The maximum specific gravity may reach 1 032 Dependent upon the degree of renal impairment the maximum specific gravity will be lowered until the *fixation level* (1 010) is reached in cases of severe *renal insufficiency* (p 2275)

The highest specific gravity may be obtained in different specimens in different patients Often the specific gravity of the first specimen is higher than the others despite the longer period of water restriction In patients with *glycosuria* and *albuminuria* the specific gravity is corrected for the presence of these substances to eliminate false high values by allowing for the grams of substance present in the urine

Interpretation—The limitation of concentrating power of the kidney is an early sensitive sign of impaired renal function In *acute nephritis* this may be the only evidence of a functional defect while other tests (phenolsulfonphthalein and urea clearance) are normal When the fixation level has been reached as in cases of *chronic nephritis* renal function has been reduced to at least 30 per cent of normal To follow the further decrease in function other tests must be used *e g* the urea clearance

It is impossible to carry out a satisfactory concentration test in an *edematous patient* for the elimination of edema fluid may mask the ability to concentrate Similarly a diet low in protein and sodium chloride may not yield enough urinary solids to cause a high specific gravity even with a small volume of urine

As with other renal function tests the influence of extrarenal factors should be separated from those that are renal *Temporary* impairment of concentrating power may be encountered in the presence of anatomic

ally intact kidneys in cases of *congestive heart failure peripheral circulatory collapse severe anemias* and in some *endocrine disorders* (Addison s disease diabetes insipidus)

The Dilution Test —The dilution test measures the ability of the kidney to excrete a large volume of water given by mouth

Technic —For the urine dilution test, the patient omits breakfast The bladder is emptied and 1200 cc of water are then drunk within ten to fifteen minutes (approximately 20 cc of water per kg of body weight) The urine is collected in a separate container at hourly intervals for four hours The *volume* and *specific gravity* of each sample are determined The patient should recline during the test as the rapidity of the water excretion is affected by posture being greater while recumbent

Results —In the presence of *normal* renal function the hourly urine volume rises gradually to a peak at the end of the second hour and then slowly falls to reach basal levels during the fourth hour The specific gravity of the urine is depressed to 1 001 to 1 002 at the height of the diuresis and tends to remain low The total volume of urine voided during the four hour diuresis period usually equals or exceeds the volume of water administered

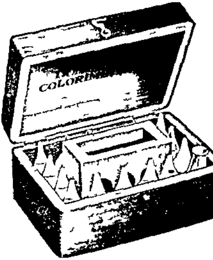


Fig 523 —The Dunning colorimeter for phenolsulphonphthalein determinations

In the presence of *renal impairment* the urine volume fails to increase in response to the administered water the excretion of water is delayed and the urine specific gravity remains more or less fixed at 1 010

The Phenolsulfonphthalein Test (Office Laboratory) —The ability of the kidney to excrete phenolsulfonphthalein injected intramuscularly affords a measure of renal efficiency Since the kidney does not normally have to excrete the substance the exact nature of the renal mechanism involved is less obvious than in the concentration test

Technic —Half an hour before the injection of the dye the patient drinks 2 glasses of water to stimulate urine formation Just prior to the injection the bladder is emptied and the urine discarded One cubic centi

* Courtesy of Hynson Westcott and Dunning

meter of phenolsulfonphthalein (6 mg) is injected intramuscularly in the deltoid or gluteal region The patient is instructed to save all the urine for the next two hours and ten minutes At the end of the first hour and ten minutes the bladder is emptied and the urine saved The second specimen is collected in a separate vessel The two specimens are examined individually for the amount of dye

To determine the *amount of dye* present enough 10 per cent sodium hydroxide is added to each specimen to bring out the red color The volume of each is then made up with water to 1000 cc A standard is prepared by adding 1 cc of the dye to 800 cc of water sufficient 10 per cent sodium hydroxide is added to alkalinize and the volume is made up to 1000 cc This is a 100 per cent standard color solution Each of the diluted alkalinized specimens of urine is compared with the standard in a colorimeter

An alternate method is to use the Dunning colorimeter* which consists of thirteen sealed ampules containing standard color solutions of different percentages There is an open ampule for the unknown and a small box for comparison of the unknown and the standards The reading is made directly in *per cent*

Results—In normal persons the dye appears in the urine *in from* five to ten minutes after injection Sixty per cent of the dye is eliminated in the first hour and about 75 to 80 per cent by the end of the second hour *Decreased excretion* indicates renal insufficiency in the absence of extrarenal or postrenal modifying factors (*heart failure obstructive uropathies*) In general there is a rough parallelism between the degree of renal insufficiency and the amount of dye excreted as shown in the following table

RELATIONSHIP OF RENAL FUNCTION AND PHENOLSULFONPHTHALEIN EXCRETION†

State of Renal Function	*PSP Excretion %*
Normal	60 or over
Slight impairment	59 to 40
Moderate impairment	39 to 25
Marked impairment	24 to 11
Maximal impairment	10 to 0

† After Mosenthal and Lewis

Failure to obtain all the urine during the collection period after the injection of dye will give a low value Low values may also occur in *edematous patients* in *collapse* in patients taking *saline cathartics* in *anesthetized* or *heavily sedated patients* and *during pregnancy* In general the sensitivity is less and is considerably lower than that of the concentration test Normal values may be obtained in patients with impaired concentrating power

Urea Clearance Test (Clinical Pathologist)—The urea clearance test developed in its modern form by Van Slyke and his coworkers measures the ability of the kidney to excrete urea

Technic—The test should be performed between breakfast and lunch The bladder is emptied and the urine discarded One hour later the pa

* Hynson Westcott and Dunning

tient voids and may be catheterized to insure complete emptying of the bladder The *volume* and *urea nitrogen content* of the one hour specimen are determined A second one hour specimen is taken in the same manner as a check At the end of the first hour blood is drawn by venipuncture for the *blood urea nitrogen determination* (p 3713)

Calculation—If the quantity of the urine voided is more than 2 cc per minute for the one hour collection period the formula used is that for maximal clearance

$$\frac{\text{U (urine urea N mg per 100 cc.)}}{\text{B (blood urea N mg per 100 cc)}} \times \text{V (cc of urine per minute)}$$

If the volume of urine is less than 2 cc per minute the standard clearance formula is used

$$\frac{\text{U (urine urea V \%)}}{\text{B (blood urea V \%)}} \times \text{V (cc of urine per minute)}$$

The *normal range* of standard clearance is from 40 to 65 cc with the mean at 54 cc while that of maximum clearance is 60 to 95 cc with the mean at 75 cc Any reduction below the lower limits indicates renal impairment Calculations may be simplified by the use of nomograms constructed by Moller McIntosh and Van Slyke

Results—In patients with renal disease the maximum standard clearances are decreased in proportion to the degree of renal impairment The chief values of this test are that it requires no special preparation of the patient and factors such as edema diet drugs or the level of blood urea have little influence on the result Moreover in patients with marked reduction in renal function in whom the phenolsulfonphthalein excretion is 0 and the specific gravity of the urine is fixed at 1 010 the urea clearance may still indicate 20 to 30 per cent of average normal renal function Urea clearance figures indicate the status of renal function at the level where other tests yield no information On the other hand in the early stages of renal insufficiency it is less sensitive than the concentration test

The *disadvantages* are obvious Accurate urine collection is essential and catheterization may be necessary Quantitative blood and urine urea determinations must be carried out False low figures are encountered during the excretion of large amounts of sodium bicarbonate

EXAMINATIONS BY THE SPECIALIST AND THEIR INDICATIONS

Urethral Endoscopy
Urethritis (p 2336) *Disturbances of Micturition* (p 2264) *Congenital Abnormalities* (p 2284)

Cystometry (p 2246)
Disturbances of Bladder Especially Neurogenic (p 2330)

Cystoscopy (p 2248)
All Disturbances of Micturition and of Urinary System

Catheterization of Ureters (p 2249)
Disturbances of Upper Urinary Tract

Passage of Waxed Tip Catheter (p 2249)
Calculus Disease (p 2311)

ANATOMIC REVIEW

U th a—See p 2393 for male p 3643 for f male

Th Un ary Bladder—The urinary bladder functions as a reservoir It is de igned to favor urinary continence The position of the adult bladder is mostly pelvic The fun lus ri e above the level of the symphysis pubis only when it is d stended The *l men* of the bladder i Y-shaped when empty ovate when full The *vesical neck* contains the or fice connecting the bladd r to the posterior urethra It posses es an *internal sphincter*

Within the bladder the vesical neck forms the apex of the *trigone* This triangular area has as its base the *interureteric ridge* (*Mercier's bar*) The *ureteral orifices* are s tuat d at each lateral margin of the interureteric ridge Each ureter runs an obl que course through the bladd r wall and for a variable listance along the interureteric ridge There is thus formed a membranous crescentic fold which acts as a valve to prevent urinary backflow The remainder of the bladder is made up by the *base* or *f ndus* the *right a d left lateral walls* the *a terior wall* and the *vertex* or *dome* (Fig 525)

The bladder is lined by a smooth mucous surface Beneath is a muscular wall called the *detrusor vesicae* This is attached to the back of the pubis at the neck of the bladder much like a toy balloon to its wooden mouthpiece

The bladder receives its main *arterial blood* from the superior inferior and middle vesical arteries branches of the anterior division of the hypogastric Th *bladder veins* do not accompany the arteries They empty anteriorly into the plexus of Santorini and the lateral plexuses

The *innervation* of the bladder is of great complexity The *pudendal nerve* sends motor branches to the striated muscle *Efferent nerves* are suppl ed through *adrenergic* (p 1391) and *cholinergic* (p 139) *divisions of the involuntary nervous system* (p 1 S8) The former fur nishes inhibitory impulses to the detrusor muscle and motor fibers to the trigone the internal sphincter and the smooth mu cle of the proximal part of the urethra Thus adrenergic drugs such as adrenalin fa or retention of urine The cholinergic system supplies motor fibers to the detrusor muscle and inhibitory fibers to the internal sphincter Thus the two divisions of the involuntary nervous system are mutually antagonistic in their action Cholinergic drugs such as physostigmine stimulate the mechanism of micturition The depressants such as atropine, behave like adrenalin

Th Ur t s—The ureters are relatively thick walled muscle tubes with a narrow lumen They conduct the urine from the pelvis of the kidney to the bladder

The ureters vary in length being about 28 to 34 cm in men and 27 to 29 cm in women The right ureter is usually about 1 cm shorter than the left due to the lower position of the right kidney

Each ureter has three points of physiological narrowing These exist at the *ureteropelvic junction* at the point of *crossing of the iliacs* and in the *juxtavesical portion* Between the first two narrowings is the *abdominal spindle* between the lower narrowings the *pelvic spindle* Ureteral stones more readily become impacted at these sites and in the intramural portion

The Renal P l s and Cal c s—The *renal pel s* is the upper expanded portion of the ureter It lies the *sinus renalis* The pelvis gives into two and occasionally three *major calices* These subdivide to form four to t el e (average 8) *minor calices* The minor calices are in vag n ted by the t ps of the *renal papillae* through which the urinary secretion is discharged

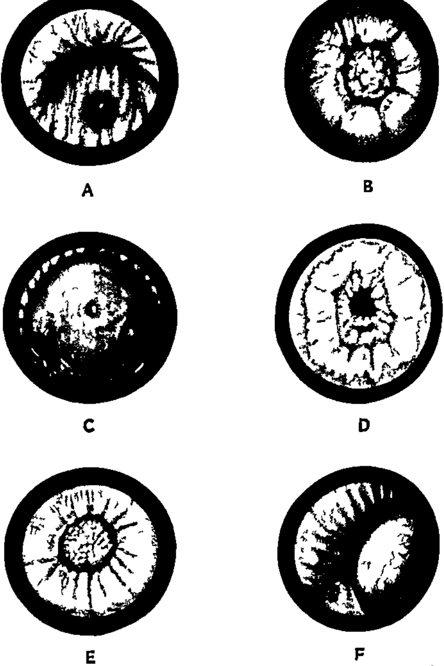


Fig 524—Urethroscope views of various lesions of the urethra *A* Orifice of a diverticulum (congenital) of the bulbous urethra *B* Carcinoma seen through the orifice of a stricture situated at the perineoscrotal junction *C* Large inflamed verumontanum *D* Strictured area of the urethra showing dense scar tissue surrounded by leukoplakia and the opening of a false passage *E* Rough phosphatic calculus seen through the orifice of a stricture *F* Cyst of the left lobe of the prostate displacing the verumontanum laterally

The renal pelvis is subdivided into extrarenal and intrarenal portions the recognition of which is important in the management of *hydronephrosis* (p 2284)

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The *capacity of the renal pelvis* varies from 5 to 10 cc An increase of the capacity beyond 15 cc suggests a pathological dilatation (*hydronephrosis*)

The pelves and ureters convey urine from kidney to bladder This is accomplished by a muscular peristalsis beginning at the minor calix and terminating by the forcing of a jet of urine through the ureteral orifice into the bladder *Pyelo-ureteral activity is not merely* a matter of simple gravitation A distinct ureteral rhythm may be recognized by pyeloscopy *Series of systoles and diastoles are recognizable*

As with the bladder the ureters possess reciprocal autonomic innervation *The cholinergic stimulants* (physostigmine etc) increase ureteral tonus and favor peristalsis The *adrenergic* stimulants (adrenalin) and vagal depressants (atropine) inhibit ureteral peristalsis

UROLOGICAL EXAMINATIONS

Urethral Endoscopy.—Endoscopy permits direct visualization of the urethral mucosa The use of the endoscope is a specialist procedure since its limited value does not justify the purchase of the instrument by the practitioner The technic of endoscopy is relatively simple as the instrument



Fig 72 —Normal cystogram (male)

is easily introduced and the findings are relatively obvious The urethra is anesthetized as for the passage of a sound The instrument is introduced in a similar manner

Normally the field of the urethral membrane appears as a conical segment with its base in contact with the inner rim of the tube The normal membrane appears in fine soft radial folds The mucosal capillaries are recognized as delicate red lines As the instrument is further introduced the color of the membrane changes from a yellowish red to a yellowish pink and finally to a yellowish white The healthy membrane appears moist shiny and smooth Under normal circumstances Littre's glands are not visible When inflamed their orifices become visible as small red or yellowish raised or vesicular areas

By *posterior urethroscopy* there may be visualized the colliculus the

openings of the ejaculatory duct the internal sphincter and the neck of the bladder

By endoscopy *inflammatory processes* are recognized *Strictures ulcerations papillomas* and *foreign bodies* are observed The latter may be removed and *neoplasms* may be destroyed or biopsied

Cystometry —The cystometer is an apparatus that consists of a catheter connected to a manometer and an irrigating apparatus A three way stop cock provides for the introduction of fluid into the bladder for the measurement of the pressure within that viscus As each 50 cc of sterile fluid is introduced into the bladder the petcock is turned to the manometer and a reading is made The patient reports the desire to urinate, the sensation of fulness or pain and the subjective symptoms are checked with the manometric pressures Finally a reading is made while the patient is straining to void

In the *normal individual* the desire to void occurs when the bladder content is around 150 cc with a pressure in the bladder of 8 to 10 mm Fulness is experienced at 200 cc and pain at 300 cc or more when the bladder pressures approximate 40 to 65 mm Straining, on the part of

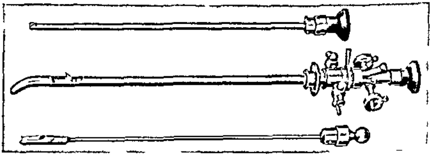


Fig 526 —Brown Buerger convex cystoscope with an examining lens system

the patient raises the pressure to 70 to 80 mm The bladder capacity of the female somewhat exceeds that of the male

Cystometry assists in the recognition of the *cord bladder* (p 2331) In this condition the curve is flat there is no contraction response to the increasing quantities of inflowing fluid an absence of a sense of pain and a tremendous bladder capacity

As opposed to the cord bladder the hypertonic bladder is characterized by a desire to void when the smaller quantities of introduced fluid cause a rapidly rising intracystic pressure

Cystoscopy —The cystoscope permits visualization and treatment of the interior and neck of the bladder Cystoscopy is a *specialist* procedure for which the patient is referred to the urologist Under ordinary circumstances the instrument is passed under local anesthesia using such preparations as 2 per cent metycaine Rarely it is necessary to use spinal anesthesia or employ general anesthetization with sodium pentothal or an inhalation gas

The cystoscope is passed under strictly sterile precautions When the bladder has been entered the obturator is removed and the bladder is

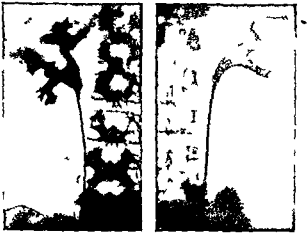
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irrigated and filled with boric acid solution or oxycyanide of mercury 1 8000 The usual capacity of the male bladder is 150 cc of the female 200-250 cc

The normal bladder mucous membrane is smooth shiny and yellowish pink Very fine blood vessel markings are evident At the roof of the bladder an air bubble is usually seen

The anatomical landmarks recognized by the cystoscopist include the interureteric ridge the trigone the orifices of the ureters the sphincteric margin and the posterior urethra (Fig 524)

Abnormalities that are easily recognized are *inflammatory lesions* of the mucous membrane with exudates and ulceration *tubercles tumors stones trabeculation diverticula ureteroceles* the presence of *valves* and



A B

Fig 527—Pyelograms A Normal There are major calyces attached to the true pelvis lower one being bifid Note minor calyx directed forward It is attached at base of lower major calyx *B* Congenital variation Superior major calyx is flattened to this are attached 5 diminutive minor calyces Latter cannot be seen in the reproduction with the exception of one occupied by the tip of ureteral catheter (indicated by arrow) Note marked elongation of lower major calyx *

cysts in the posterior urethra *deformities* of the colliculus due to enlargement of the median bar of the prostate or other *prostatic hypertrophies*

Cystoscopy is of additional therapeutic usefulness *Biopsy specimens* may be taken from the bladder *Radon seeds* may be implanted Bladder tumors may be destroyed by *fulguration Impacted ureteral calculi* may be dislodged by the opaque catheters or they may be facilitated in their passage by the instillation of oil or a local anesthetic or both A *hydronephrosis* or a *pyonephrosis* of the kidney may be drained Large *stones* can be crushed and the fragments irrigated out

The ureteral orifices are particularly observed for the passage of urine containing blood or pus and the concentration of test dyes administered intramuscularly or intravenously

Catheterization of Ureters —After the bladder has been completely in

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openings of the ejaculatory duct the internal sphincter and the neck of the bladder

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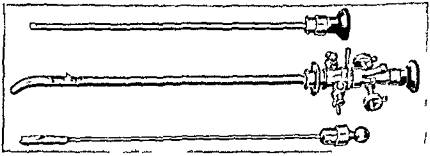


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of a scout film This provides an insight into the size configuration and position of the kidneys the clarity of the psoas shadow the presence of calcific shadows in the region of the kidney pelvis the ureters or the bladder and the appearance of the lumbosacral spine and the pelvic bones

Extraurinary shadows may be encountered Thus *phleboliths* are usually multiple and bilateral The individual shadow is smooth and sharply demarcated with a hollow center Phleboliths are most often found near the ischial spine *Calcified mesenteric lymph nodes* are usually fuzzy with an irregular outline and are often in the region of the meso appendix In final analysis however the differential diagnosis between intra and extra ureteral calcifications rests upon the passage of the opaque catheter in order to observe the relationship between the suspected area and the actually demonstrable lumen of the ureter

In interpreting shadows it is to be remembered that not all urinary calculi are visible in the radiograph Pure uric acid and cystine stones do not obstruct the rays

Retrograde Pyelography—For retrograde pyelography a 12 per cent solution of sodium iodide or a 35 per cent solution of any organic iodide substance is injected through the ureteral catheters preferably by gravity but certainly not at a pressure to exceed 20 mm of mercury When the patient complains of fulness in the renal region the injection is *interrupted* and the film is exposed

For technical reasons the *interpretation* of pyelograms is fraught with considerable difficulty particularly the occurrence of the pyelovenous backflow However the typical normal renal pelvis is roughly triangular and is usually situated at the level of the transverse process of the second lumbar vertebra There are usually three major calices (superior middle and *inferior*) *with six to twelve minor calices Normally these are sharply* defined and cupped The ureters normally make a gentle curve at the point of union with the pelvis and follow a course down toward the bladder The normal caliber of the ureter is roughly compared to the width of the lead of a pencil the normal ureter should not be larger Retrograde pyelography is contraindicated in the presence of acute urinary infection or renal insufficiency It is not wise to impose retrograde pyelography on both ureters at a single sitting Urinary fevers shock sepsis anuria and local irritative phenomena may occur from this type of examination which has been mostly replaced by *intravenous pyelography* and *urography*

Intravenous or Excretion Urography—Intravenous or excretion urography relies on the excretion by the kidney of the introduced opaque mixture usually an organic iodine solution injected intravenously The preparations in most common use are neo iopax skiodan diodrast hippurin and diodrast compound These preparations are commercially available

Before injection a scout film is taken and compression made over the urinary bladder region so as to more clearly delineate the renal pelvis and the upper ureter Later the compression may be removed when the bladder shadows are studied The solutions are slowly injected intravenously and films are taken five to ten minutes following the injection and at five to fifteen minute intervals thereafter until the entire urinary tract and bladder have been visualized

vestigated by cystoscopy the expert catheterizes the individual ureters Absent or multiple ureteral orifices are noted The ureteral catheters are passed up into the pelvis a distance which averages approximately 30 cm Any obstruction is measured The presence of blood or pus flowing along side of the catheter requires further explanation

The normal capacity of the renal pelvis is 4 to 8 cc Individual ureteral specimens of urine are collected for more complete examination in order to determine the presence of unilateral renal disease Microscopically the presence of *blood* and *pus* is noted *Urea determinations* are done on the individual specimens to observe the differential renal function *Bacteriological examinations* are made in infectious processes The specimen is centrifuged and concentrated to be stained for *tubercle bacilli* when an infection is suspected Finally the ureteral specimens are examined for the

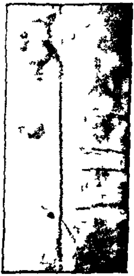


Fig 598—Peculiar normal pyelogram in association with a large calcified retroperitoneal lymph node Note that two superior minor calices are directed medianward—a most unusual occurrence in absence of malrotation of the kidney or horseshoe kidney *

concentration of the dyes employed for functional tests Either indigo carmine or phenolsulfonphthalein is employed

With the ureteral catheters in place *radiographs* of the urinary tract delineate the opaque catheters and enable the physician to differentiate between extraureteral shadows such as calcified lymph nodes and true intraureteral shadows which are usually calculi (Fig 552)

Radiography of the Urinary Tract—Many ingenious methods have been devised by which the urologist and radiologist visualize the urinary tract Urography and pyelography are accomplished by the *retrograde* and *intravenous methods* The perirenal insufflation of oxygen provides a contrast medium for the upper pole of the kidney and particularly the adrenal glands Even the seminal vesicles may be investigated by the injection of contrast media

Scout Film —Any type of urography is preceded by the exposure

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Fig 5 0—Roentgenograms after insufflation of air into perirenal spaces A Case of suspected adrenal tumor (bilateral insufflation) (Penna Hosp case) B Case of pleochromo cytoma of the left adrenal gland (oblique roentgenogram)



Fig 531—Roentgenogram of the seminal tract Th injection was m de into each vas deferens and the flu d has d lated th prox mal structures or both sides and escaped via the urethra into the bladder On one side it has pas ed nto the epididymal tube†

Courtesy of Dr Edwin Beer From Herman The Practice of Urology
† Courtesy of Dr Harry C Rolnick From Pelouze Office Urology

Excretion urography depends for its success upon the functional activity of the kidney parenchyma Thus renal and extrarenal factors modify the interpretation of the shadows that result The normal kidney possesses the ability to excrete the urographic substance in high concentration over a short period This 'thrust excretion' ability is the factor upon which the success of excretion urography depends With a poor concentration power in the kidney the roentgenologic visualization is correspondingly poor or absent The functional activity of the kidney may be temporarily diminished or perhaps totally inhibited as the result of occluding lesions trauma, or neurogenic influences Nonvisualization of the urinary tract *therefore* must not be interpreted as necessarily indicating any permanent impairment of renal function In the presence of a hydronephrosis good



Fig 529—Intravenous urogram (normal) Renal shadows are much intensified and pelves and calices are shown in detail

visualization may occur despite the presence of relatively little intact functioning renal tissue

Intravenous or excretion urography is a most valuable and simple procedure but one which cannot entirely replace cystoscopy and retro grade pyelography Rather it supplements these measures and adds its data to the general information It may be used as a sole method of ex amination under certain circumstances as for example the presence of *hematuria obstructing lesions in young children* in whom instrumenta tion is difficult in adults in whom instrumentation is contraindicated due to *infection* or *fear* The only contraindication to excretion urography is diminished concentrating power of the kidney in the actual presence of uremia and azotemia

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from escaping by a urethral clamp placed about the tip of the penis Pressure is maintained for five minutes during which time the posterior urethra is gently massaged

The normal urethra should permit the passage of a number 22 M sound Before attempting to pass this caliber instrument the number 16 should be employed If this passed without pain or obstruction the larger size is to be employed

Exploration of the urethra may be carried out with a silk woven olive tipped bougie or a straight or curved metal sound The manipulation is carried out under strict aseptic precautions The external meatus is wiped clean with a sponge dipped in a solution of bichloride of mercury 1 1000 The sterile instrument is then thoroughly lubricated and grasped by the gloved hand An additional supply of lubricant is also placed in the meatus

The penis is held outstretched between the thumb index and middle fingers of the left hand All manipulation is carried out gently The metal sound particularly is permitted to pass by its own weight Only in this way may trauma be avoided Normally there are *three points of slight resistance*—at the fossa navicularis the penile-scrotal junction and the external sphincter of the bladder

If the number 16 M passes without obstruction the number 22 is then employed The caliber of the urethra is considered normal if it takes the number 22 M Should it be impossible to pass the 16 M smaller instruments are introduced When the narrowing is so extreme as to prevent the introduction of a number 6 M filiform bougies are used This procedure is best referred to the specialist urologist

Filiform bougies are of three types i e straight curved or bayonette These are cautiously manipulated through the urethra and maintained in situ to dilate the stricture At the next treatment the passage of a somewhat larger instrument may be possible

Irrigation of the Bladder—A sterile bottle of 1 to 2 quart capacity with an opening at the bottom is suspended two feet above the level of the patient A piece of sterile rubber tubing about 4 feet in length is connected to the bottle at one end and to a small glass connecting tube at the other The glass tube should be previously fitted to the catheter to insure a snug connection Enough solution is run through the tube to displace the air and the tube is clamped

The patient is catheterized in the usual fashion except that a soft rubber number 16 catheter is employed in the female The bladder is *emptied by allowing the urine to flow through the catheter into a pus* basin The glass connecting tube is then inserted into the catheter the clamp opened and 200 to 300 cc of irrigating fluid allowed to run into the bladder When the patient has a sensation of distention in the suprapubic region the rubber tube is clamped the glass connecting tube withdrawn from the catheter and the bladder contents drained through the latter into the basin

The filling and emptying of the bladder is repeated until the return flow is clear With the use of a Y tube and two clamps it is possible to introduce fluid through one arm of the tube and discharge it through the other without disconnecting the catheter at each irrigation

Dietotherapy—Dietotherapy (p 680) is extensively used in uropathies

Cystography—The vesical shadow may be studied after retrograde or intravenous urography If a purely local study is required the bladder is emptied by catheter and then filled to the point of slight discomfort with 3 to 5 per cent of sodium iodide or any of the organic iodide compounds Exposures are made in the anteroposterior oblique and lateral positions The bladder is then emptied and filled with air and another anteroposterior roentgenogram is obtained

The normal appearance is a homogeneous globular shadow with a smooth edge

Perirenal Pneumoradiography—Perirenal pneumoradiography requires the injection of oxygen around the kidney This is a technically difficult procedure that requires the services of the expert since there is a danger of air embolism and infection The method is employed to delineate *tumors of the adrenal gland*

Seminal Vesiculography—Seminal vesiculography requires an injection of opaque media into the ejaculatory ducts The technic is difficult The results are not entirely satisfactory and the procedure is distinctly of limited value even in the hands of an expert

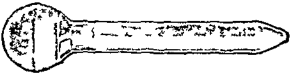


Fig 532—The safe t type of syringe for urethral injections

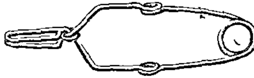


Fig 533—Penis clamp *

METHODS OF TREATMENT

The practitioner has a wide repertory of therapeutic adjuvants for the relief of urologic disorders They include instrumental technics diet and the administration of drugs and antibiotic agents

Urethral Irrigation—Urethral irrigations require the use of a special urethral syringe containing a removable rubber bulb A glass type of 8 cc capacity kept sterile by immersion in alcohol is most useful The urethra is gently distended by the solution (usually 4 to 5 cc) By digital pressure or a metal penis clamp the fluid is retained for several moments before it is allowed to flow out

Dilatation of the Urethra—The male urethra may be dilated with the *bougie* or the *sound* The introduction of either instrument is associated with a certain amount of discomfort and even pain *Preliminary local anesthetization* is warranted before any endo urethral manipulation is attempted For this purpose 20 to 30 cc of 1 500 nupercaine or 2 per cent metycaine are injected with a urethral syringe The solution is prevented

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fancied It is good practice to alternate the period of mandelic acid therapy with a few days of administration of sodium bicarbonate

Antibiotics.—Introduction of antibiotics has revolutionized the treatment of urinary tract infection Sulfonamides and penicillin brilliantly successful in the management of gram negative (gonococcal) and gram positive (streptococcal and staphylococcal) invasions may be overshadowed by the accomplishments of streptomycin (p 104) in the control of urinary sepsis caused by coliform organisms Of the antibiotics sulfonamides can be given effectually by mouth penicillin and streptomycin yield best results after intramuscular injection In all instances urinary excretion of the antibiotic produces antibacterial concentrations When bacteriologic reports are un availing any two or all three of the preparations can be given in sequence or concurrently

THE DIURETICS

The secretion of urine requires an adequate renal circulation sufficient body water for the excretion of metabolic waste products and a free passage of fluid to and fro between the capillaries and the tissues Failure of any of these mechanisms favors the onset of oliguria and may lead to a temporary impairment of renal function the so-called *pre renal azotemia*

Substances that promote the excretion of urine may act extrarenally and indirectly or they may have a direct effect on the renal parenchyma The latter are the true diuretics The true diuretics must appear in the urine to be effective Hence there is required a careful evaluation of the functional status of the kidney and an accurate measurement of fluid balance to prevent excessive water loss In the presence of severe renal impairment the blood may not be cleared of substances administered as diuretics with the result that appreciable retention of the e preparations may produce untoward effects Many diuretics particularly mercurials injure the renal tubules and may produce a serious increase in renal damage in those patients who have renal insufficiency Energetic diuresis especially when combined with water and salt restriction as practiced in the treatment of cardiac or nephrotic edema may lead to serious dehydra tion

In considering the water retention which requires correction the under lying pathogenic mechanisms should be sought Treatment may consist not only of removing the cause but of the application of synergistic meas ures Thus in cardiac edema the beginning of the vicious cycle is the in crease in capillary venous hydrostatic pressure The capillary permeability is then impaired Because of restricted food and salt intake there is a depletion of plasma protein and plasma chloride followed by a greater loss of water from the blood to the interstitial water compartment Unless the heart failure is extreme the kidney function may remain intact but the kidney cannot excrete water which is outside of the blood volume

Diuresis here is best initiated by digitalization with correction of the capillary hydrostatic pressure by the improved heart action A drug such as mercupurin which diminishes the tubular reabsorption will start a diuresis in the cardiac patient but since it does not treat the abnormal hydrostatic pressure the edema has a tendency to recur The use of digitalis to treat the circulatory cause followed by acidotic drugs and

Acid ash and ketogenic diets are indicated in *urinary infections* high protein diets are valuable in *nephrosis* and a low protein intake may be required in *azotemia* Diets low in calcium oxalate and uric acid are advocated in *lithiasis* (p 679)

THE URINARY ANTISEPTICS

The number of urinary antiseptics has been strikingly reduced in recent years due to the introduction of powerful agencies such as mandelic acid penicillin streptomycin and the sulfonamides

Volatile Oils—Previously a large number of useless or at best feebly effective drugs were employed by the urologist The volatile oils *sandal wood copaiba* and *cubeb* were given orally with the hope of sterilizing the urine in gonorrhea There was never the slightest reason to expect any therapeutic efficacy but the use of the drugs was so widespread as to become routinized

Dyes—A number of dyes have been employed mainly because their staining reaction in the urine carried with it the promise of some bactericidal activity Outside of the tinctorial effect there is little excuse for the popularity of these preparations which included *acriflavin hexyl resorcinol methylene blue* and *pyridium* Of these dyes only the latter an azo derivative is still widely employed and it has been reported upon unfavorably by the Council on Pharmacy of the American Medical Association

Methenamine (Urotropin)—Few drugs have been introduced in medicine with such fanfare as methenamine (urotropin) which was advocated as a urinary antiseptic as well as a powerful bactericidal agency for other body fluids including the spinal fluid Methenamine has no important efficacy except in an acid medium so that all effects other than in the acid urine may be immediately discounted Given in 0 5 gm (7½ grains) doses every four hours with sodium biphosphate 1 0 to 2 5 gm (15 to 38 grains) every four hours beginning two hours after the urotropin the methenamine has some bactericidal efficacy probably as much due to the reaction of the urine as to the specific molecular effect Certainly its efficacy cannot be compared with mandelic acid or the sulfonamides except in the treatment of infections caused by certain resistant strains of E coli

Sodium Bicarbonate—Bicarbonate of soda is employed as a urinary antiseptic in an attempt to destroy those organisms which cannot survive a highly alkaline medium It may be used alternatively with the acid producing substances such as mandelic acid or the ketogenic diet Its value is dubious

Mandelic Acid—The acidifying preparations of great utility as urinary antiseptics include ketogenic diet and the simpler preparation of mandelic acid Mandelic acid is best prescribed as the calcium salt It is given in 3 gm (45 grains) dosage four times daily for ten to twelve days The urinary output is limited to 1 liter daily and to this end the patient is requested to take limited fluid not to exceed 1200 cc daily

The acidifying urinary antiseptics are particularly useful in the treatment of gram negative invasion with E coli Shigella and Salmonella organisms The efficacy of mandelic acid has led virtually to the abandonment of all of the above mentioned urinary antiseptics b [illegible]

The *substances that decrease tubular reabsorption* include

1 Osmotic Diuretics
   (a) Salts—potassium chloride ammonium chloride calcium chloride
   (b) Organic compounds—urea glucose sucrose sorbitol
   (c) Hormones—parathyroid extract
2 Tubular Depressants
   (a) Mercurials—calomel merbaphen mersalyl mercupurin
   (b) Xanthines—caffeine theobromine theophylline
3 Inhibitors of the Neurohypophysis
   (a) Water

Individual Diuretics —*Potassium Salts* —Potassium salts appear rapidly in the urine and are rejected completely by the tubules with appreciable amounts of water Their effectiveness as diuretics is enhanced by the restriction of sodium chloride They give best results in cardiac edema and are often useful in the nephrotic syndrome Their use should be limited to patients with good renal function in order to avoid an elevation of the blood potassium concentration Potassium retention causes nausea and vomiting and may lead to shock

Potassium nitrate is the best diuretic potassium chloride potassium bicarbonate potassium acetate and potassium citrate may be used but are less effective The usual daily dose of potassium nitrate or potassium chloride is from 5 to 10 gm (75 to 150 grains) given orally at or immediately after meals in 0.5 gm capsules or enteric coated pills Five grams (75 grains) of potassium chloride may be given daily sprinkled on the food from a salt shaker

Acid Producing Salts —Ammonium chloride ammonium nitrate and calcium chloride are effective diuretics The diuresis obtained from the action of these salts is greater than would be expected from their osmotic effects and depends in part on the liberation of an acid radical within the body In the case of the ammonium salts the ammonium ion is rapidly converted into urea with the freeing of the acid radical Calcium chloride dissociates in the intestine the calcium is not absorbed while chloride readily passes into the body fluids

These salts are useful in cardiac edema in the nephrotic syndrome and in cirrhosis with ascites They are most effective when given in conjunction with mercurial diuretics (p 2261) They should be avoided in the presence of impaired kidney function since they will induce a severe acidosis Their use is contraindicated in the presence of an elevated blood urea These compounds also are useful in the treatment of urinary infections lead poisoning and epilepsy (p 1515) and are effective in combating alkalosis

Ammonium chloride ammonium nitrate and calcium chloride cause diuresis only if given in large doses They are best administered in enteric coated pills or in lemonade in divided doses to total 9 to 12 gm (135 to 180 grams) daily Nausea and vomiting are common during the administration of these salts Ammonium nitrate may cause methemoglobinuria

Urea —Urea is reabsorbed poorly from the glomerular filtrate and

mercupurin if necessary to mobilize the edema fluid, will have a more prolonged effect

Increasing the plasma proteins by correcting the low protein diet may be especially helpful in edema and ascites complicating cirrhosis of the liver In fact lyophile plasma or blood transfusions may help in increasing the osmotic pressure of the blood

The *edema of acute glomerulonephritis* which is due to injury of the capillary tufts of the glomeruli cannot be treated as yet as no drug is known to decrease abnormal capillary permeability

From a therapeutic point of view it is important for a physician to have and to exercise the clinical judgment necessary to know when and how to induce diuresis by modalities which operate extrarenally and therefore are not technically speaking true diuretics"

Classification of Diuretics—Diuretics increase urine volume by modifying existing renal mechanisms The predominant mode of action may be an increase in glomerular filtration or diminution in tubular reabsorption In the presence of an adequate renal circulation a reduction in tubular reabsorption has the greater influence on urine volume A 1 per cent reduction in the tubular reabsorption of water will double the urine volume while a 100 per cent increase in glomerular filtration is necessary to produce the same change Thus it is doubtful whether substances that merely increase filtration are of much therapeutic importance Fortunately substances that increase filtration (water salts and osmotically active organic compounds such as carbohydrates and urea) produce their principal diuretic effects by limiting tubular reabsorption

Tubular reabsorption may be limited (1) by increasing the concentration of osmotically active substances in the urine and thus restricting the amount of water that can be reabsorbed against the osmotic pressure of these substances (2) by direct depression of the reabsorption activity of the renal tubules and (3) by freeing the tubules from the influence of the antidiuretic hormone of the posterior pituitary gland

The concentration of osmotic solutes in the urine is increased by the administration of inorganic salts and certain organic compounds Hormones contribute to osmotic diuresis by increasing the excretion of inorganic solutes For example the diuresis produced by parathyroid extract is associated with a rise in the calcium and phosphorus content of the urine

Tubular depression is accomplished by the administration of the mercurials and xanthines The diuresis produced by water results from the liberation of the tubules from the antidiuretic control of the posterior hypophysis in response to an increased water loading of the tissues Water diuresis cannot be depended on in the treatment of edema

The *substances that increase glomerular filtration* include

1 Water (p 587)
2 Hypertonic Salt Solutions
3 Organic Compounds—carbohydrates urea acacia plasma protein
4 Xanthines (p 2260)
5 Pituitary Extracts (p 1178)

phyllin) Dosage is 0 1 to 0 3 gm (1½ to 5 grains) orally three to five times daily If diuresis doesn t result within two or three days it is likely that further therapy will be ineffective Theophylline Ethylene Diamine may be given intravenously in doses of 0 24 gm (4 grains) in 10 cc of distilled water

Theobromine is less effective as a diuretic than Theophylline It may be administered in doses of 0 6 gm (10 grains) three to five times daily The soluble double salts are more popular Theobromine with Sodium Salicylate (Diuretin) is perhaps the best known of the xanthine diuretics Theobromine sodium acetate and calcium theobromine and calcium salicylate may also be used The dose of the double salts is 1 0 gm (15 grains) three to five times daily Nausea and vomiting are common

Mercurials.—Mercury compounds are the most powerful and the most reliable diuretic agents available Their activity resides in the direct depression of the tubule cells by the mercury ion The process of reabsorption is impaired and increased quantities of water and sodium chloride appear in the urine This represents a mild toxic action of mercury on the kidney and emphasizes the need for caution in the use of mercury in patients with renal damage

With the exception of calomel (mercurous chloride) mercurial diuretics are organic compounds that liberate ionic mercury slowly in the body Calomel an ingredient of the historical Guy s pill (calomel squills and digitalis) has been displaced because of the excessive diarrhea that accompanies the diuresis The organic mercurials are approximately equal in activity and toxicity Their chief usefulness is in the treatment of *cardiac edema* Diuresis is less consistently observed in the nephrotic syndrome and in cirrhosis with ascites The effectiveness of the organic mercurial is increased by the simultaneous use of acid producing salts The resulting diuresis is greater than when these drugs are used singly The best results are obtained by giving 9 to 12 gm (135 to 180 grains) of ammonium chloride for two days preceding the injection of the mercurial and on the day of injection The organic mercury *diuretics are given intramuscularly In travenous injection may be followed by immediate acute vasomotor collapse and death For some unknown reason this type of severe reaction is most likely to occur in patients with the nephrotic syndrome* Paravenous infiltration causes painful sloughs Intraperitoneal injections are often strikingly effective in patients with cirrhosis and massive ascites In this condition the mercurial is diluted with 10 cc of ascitic fluid before injection Stomatitis diffuse dermatitis diarrhea hematuria anuria and progressive renal insufficiency may be encountered after the injection of mercury as a diuretic

PREPARATIONS —*Merbaphen* was the first organic mercurial to be used as a diuretic This is the double salt of sodium mercurichlorphenyl oxyacetate with diethyl barbituric acid and contains 34 per cent mercury It is the most toxic of the organic mercurials and should be used only when the others are unavailable The dose is 1–2 cc (15 to 30 minims) of a 10 per cent solution intravenously *Sloughing and toxic reactions are somewhat more common than with the other members of this group*

brings about considerable water loss It is a valuable diuretic in the presence of good renal function It is particularly useful in cardiac edema and is somewhat less effective in nephrotic edema It must be given in large doses 20 to 30 gm (5 drams to 1 ounce) three time daily in lemonade or in capsules Fifty per cent syrup of acacia is a good vehicle to disguise its unpleasant taste It causes nausea vomiting and intense thirst The incidence of gastric intolerance parallels the effect of urea on the blood nonprotein nitrogen It possible the blood urea level should be followed and the drug should be discontinued when the blood urea rises above 50 mg per cent

Dextrose Sucrose Sorbitol—Dextrose sucrose and sorbitol produce diuresis by osmotic limitation of water reabsorption *Dextrose* is the least effective since large quantities are deposited in the liver as glycogen It must be given parenterally in large doses in order to exceed the renal threshold and appear in the urine The usual diuretic dose is 50 to 100 cc of a 50 per cent solution injected intravenously This produces a hydremia which may initiate diuresis Hypertonic glucose is useful to produce local dehydration in pulmonary edema of cardiac origin in bronchial asthma and in some cases of cerebral edema associated with head injury brain tumor and vascular disease Its use in cardiac patients is dangerous because the sudden increase in plasma volume may overload the heart Isotonic (10 per cent) and hypotonic (5 per cent) glucose infusions are good diuretics because of the water they contain The small quantity of glucose present is metabolized The water causes diuresis by inhibiting the pituitary control of the reabsorption of water by the kidney

Sucrose is more efficient than glucose as a diuretic since it is not metabolized Its action is more certain and lasts longer The usual dose is 100 cc of a 50 per cent solution intravenously The indications are the same as for hypertonic glucose Repeated sucrose injections are nephrotoxic and are best avoided in patients with kidney disease

Sorbitol an inert sugar is similar to sucrose in diuretic activity Unlike sucrose it has no injurious renal effects The dose and indications are the same as for glucose and sucrose These compounds may cause venous thrombosis at the site of injection

Xanthines—Caffeine theobromine and theophylline are useful diuretics but have been supplanted by the more powerful mercurials The mode of action of the xanthines is not certain Apparently they increase the renal blood flow and the number of glomeruli functioning at any one time However clearance studies during xanthine diuresis suggest that their chief function is to produce tubular depression Xanthines have the advantage that they can be given orally and have few toxic effects They are most effective in *congestive heart failure* but are less active than the mercurials Caffeine (p 3888) is not used because its diuretic action is slight and short lived and it produces nervous symptoms sleeplessness and restlessness

Theophylline is the most potent of the xanthine diuretics and is free of central nervous system effects However it is likely to cause nausea and vomiting Because of its insolubility more soluble double salts are usually employed such as Theophylline with Sodium Acetate Theophylline Calcium Salicylate and Theophylline Ethylene Diamine (Amino

PROSTATIC MASSAGE

Urologists are increasingly aware of the futility of prostatic massage in the treatment of infected or hypertrophied glands. Little benefit is anticipated and much damage may be caused by overzealousness.

TREATMENT BY THE UROLOGIST

Few specialties have undergone such marked changes as the relatively young subdivision of urology. It was not so long ago that urology, dermatology and syphilology were practiced by one man whose main problem was usually the management of acute and chronic gonorrhea and their complications. With the introduction of visual instruments to examine the urinary tract, urology was born and came of age so that many experts abandoned dermatology and syphilology and devoted themselves wholly to the study and treatment of abnormalities of the urinary passages.

NON OPERATIVE UROLOGY

The non operative devices practiced by the urologist include local and topical *irrigations* and *instillations into the urethra* (p 2254), the *passage of bougies* and *sounds* (p 2254) for dilatation of the lumen, *catheterization of the bladder* (p 2236), *cystoscopic removal* (p 2248) of urinary calculi (endoscopic litholapaxy), *effulguration* of bladder tumors, *bladder irrigations* (p 2255), *catheterization of the ureters* (p 2249) with lavage of the renal pelves, instrumental removal of impacted ureteral stones and *prostatic massage* (p 2263).

OPERATIVE UROLOGY

Operative treatment by the urologist is widely employed. The common procedures include *circumcision* (p 3396), *meatotomy* to enlarge the urethral meatus, *excision of urethral strictures* (urethrotomy), *cystotomy* to remove large bladder calculi and destroy tumors, *cystostomy* to drain the urinary bladder when there is obstruction as from prostatic hypertrophy and *cystectomy* with ureteral transplantation for malignancy, *prostectomy* by transurethral, suprapubic or perineal methods, *ureterotomy* for the removal of impacted urinary calculi, *pyelotomy* and *nephrotomy* for the removal of pelvic and renal calculi, *nephrostomy* for drainage and *nephrectomy* for the removal of a grossly infected kidney or one that is the site of a malignancy, *decapsulation* of the kidney in the nephropathies, drainage of the perinephric space for abscess and furuncles of the renal cortex, and *nephropexy* for the ptotic kidney.

Urinary tract surgery should be preceded and followed by antibiotic therapy using sulfadiazine or sulfathiazole and streptomycin or penicillin.

Salyrgan is a complex organic compound prepared from mercury acetate methyl alcohol and salicyl allylamino o acetic acid and dispensed as the sodium salt of this compound It contains 39 per cent mercury It is a better diuretic than merbaphen and less toxic The dose is 1 to 2 cc (15 to 30 minims) of a 10 per cent solution intramuscularly *Salyrgan Theophylline* solution contains 10 per cent salyrgan and 5 per cent theophylline by weight and has the same advantages claimed for mercupurin Its dose is 1 to 2 cc (15 to 30 minims) For oral administration, enteric coated tablets of salyrgan theophylline are available They contain 0 08 gm of salyrgan and 0 04 gm theophylline They may be given with or without ammonium chloride in a single dose of 2 to 5 or as 1 tablet 3 or 4 times daily for 1 or 2 days

Mercurin is a mixture of 20 per cent of the propylamide of trimethyl cyclopentane dicarboxylic acid and 80 per cent of the sodium salt. It contains 40 per cent mercury Its chief advantage is that it may be given rectally and has a diuretic potency by this route comparable to that of parenterally administered mercurials The drug is supplied in the form of cocoa butter suppositories each containing 0.5 gm (7½ grains) of mercurin

Mercuhydrin a newer diuretic contains 39 mg of organic mercury and 48 mg of theophylline per cc The intramuscular dose of 1 to 2 cc is well tolerated

Mercupurin is an aqueous solution of equivalent quantities of mercurin and theophylline in chemical combination Each cubic centimeter contains 39 mg of mercury The presence of theophylline in the compound is believed to enhance the rate and completeness of absorption of the drug It is given intramuscularly The dose is 1 to 2 cc (15 to 30 minims) of a 10 per cent solution A test dose of 0.5 cc (7½ minims) should be given first

ANTIDIURETICS

The most effective antidiuretic employed in the treatment of diabetes insipidus is *posterior pituitary extract* (p 1179)

ANTISPASMODICS

Relaxation of spasm is sought in renal and ureteral colics bladder irritability and perineal spasms The effectual drugs include demerol in 50 to 100 mg doses papaverine 60 to 120 mg atropine sulfate 1 mg and atropine like preparations particularly trasentin 60 mg

MUSCLE STIMULANTS

Stimulation of muscle is desirable in urinary retention due to atony The most potent remedies in our experience have been neostigmine 1 cc of 1 2000 solution doryl and pitressin (p 1179)

CORSETS

A well fitting corset may prevent attacks of intermittent hydronephrosis in nephroptosis (p 2293)

ness of the obstruction and the tempo of the obstructing process Obstruction is always attended by stasis of urine dilatation of the structures proximal to the block and elevation of intratubular and intraglomerular *pressures* hindering the formation of the glomerular filtrate Infection is a common sequel and the *renal parenchyma eventually undergoes pressure atrophy*

Classification —The urinary obstruction may be *infravesical* or *supravesical* An infravesical lesion is present at any point from the internal sphincter of the bladder to the external urethral opening An obstruction

DIFFERENTIAL DIAGNOSIS OF

Incontinence of Urine and Enuresis (Bed Wetting)

True incontinence of urine exists when catheterization fails to reveal residual urine Paradoxical incontinence is the overflow observed in conjunction with retention of urine (p 2264) The diagnostic table that follows refers only to true incontinence and assumes that the presence of the paradoxical variety has been eliminated by a positive yield following successful passage of a catheter (p 2236)

Enuresis in childhood or adult life is a particular type of incontinence in which bed wetting occurs at night

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Psychogenic	Especially nocturnal enuresis in childhood In the major psychoses particularly schizophrenia (p 1364)
Neurogenic	*In the senile All conditions associated with coma or depression of consciousness* (p 1294) Supplement neurologic examination with x rays and examinations of cerebrospinal fluid where indicated (p 3734) Tabes dorsalis and general paresis with positive Wassermann and gold curve in cerebrospinal fluid (p 3736)
Urologic	Congenital disturbances such as phimosis urethrocele urethral stenoses and disturbances of the urethral valves Refer to urologist for urethroscopy Following injuries inflammations or tumors involving the bladder sphincter as revealed by cystoscopy (p 2248) Impaction of calculi (p 2311)
Pelvic	Hypertrophic prostatitis Prostatic calculi demonstrable by x ray Before and after prostatectomy particularly transurethral procedures In late pregnancy With cystocele and urethral fistula

of this type usually affects both upper urinary tracts and is recognized by the early disturbances of micturition

Supravesical obstruction is confined to the ureterorenal portion of the tract and is usually *unilateral In many cases the condition is asymptomatic* and considerable renal damage has occurred before the existence of the lesion is recognized

ETIOLOGY

Urinary obstruction is caused by a wide variety of disorders These include congenital anomalies neoplasms calculi *injuries infections* and

CHAPTER 107

THE URINARY SYSTEM PATHOLOGIC PHYSIOLOGY

Disorders of Micturition
Urinary Obstruction
Renal Ischemia
Renal Insufficiency

DISORDERS OF MICTURITION

DISTURBANCES of voluntary control over the reservoir function of the bladder result from mechanical neurogenic or psychogenic factors The clinical manifestations are retention or incontinence of urine and enuresis

DIFFERENTIAL DIAGNOSIS OF

Retention of Urine

Retention of urine is differentiated from anuria (p 2232) in that catheterization of the bladder yields an amount of urine that is usually in excess of normal bladder capacity and may be as great as 1000 to 2000 cc Retention of urine may be masked by paradoxical incontinence in which there is constant or intermittent dribbling of overflow

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	In hysteria
Neurogenic	With any type of coma Cord lesions such as transverse myelitis neoplasms multiple sclerosis tabes dorsalis and general paresis Supplement neurologic examination by Wassermann tests and gold curve of cerebrospinal fluid (p 3736)
Traumatic	Injuries to penis or kidneys Penpenile hematomas Angioneurotic edema of penis or vulva Trauma during labor and pelvic operations
Urologic	Obstructive uropathies best delineated by urethrography urography cystography and cystoscopy (p 2248) Congenital anomalies such as absent or imperforate urethra
Pelvic	Pressure of large tumors of uterus Weight of pregnant uterus Endometriosis associated with dysmenorrhea and uterine fixation Following colectomy and other pelvic operations
Pharmacodynamic	Following anesthesia poisoning or overdosage with opiates hypnotics and sedatives After caudal or spinal anesthesia

URINARY OBSTRUCTION

Almost all pathologic conditions of the urinary tract interfere with the free passage of urine and produce some degree of urinary obstruction and in all instances the effects of the obstruction are qualitatively the same The chief clinical differences are due to the site of the lesion the complete-

neurogenic disturbances *In children* congenital malformations are the commonest etiologic factors their early recognition and treatment are of *importance in modern preventive medicine* *In adults* obstruction is most often due to prostatic or calculous disease and the late sequels of infection particularly gonorrhea

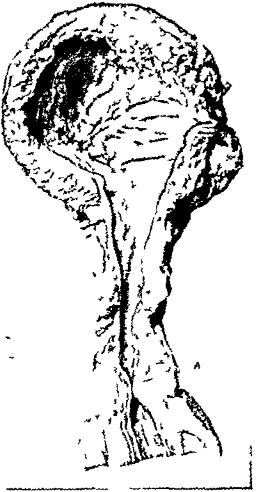


Fig 635 —Gonorrheal stricture of the urethra At *A* the urethral canal is surrounded by scar tissue and greatly narrowed There is hypertrophy of the bladder

PATHOLOGY

Obstruction from whatever cause produces typical changes in the portions of the urinary apparatus proximal to the offending lesion Mechanical disturbances may be *complete* or *partial* *temporary* or *intermittent* Calculus obstruction is usually partial it may become complete at a later stage when edema bleeding and infection are superimposed Intermittent obstruction is characteristically seen with kinking of the ureter as in the classical Dietl s crisis (p 2295)

MacCallum, Textbook of Pathology

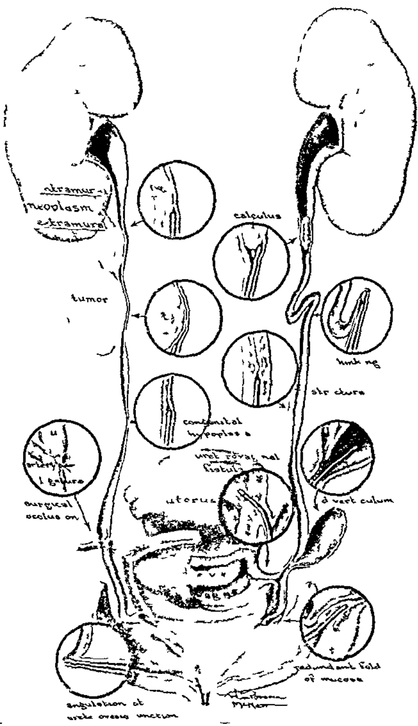


Fig. [illegible]34—Schematic drawing showing various ureteral lesions that offer obstruction to passage of the catheter It may be impossible to engage tip of catheter in the ureteral orifice owing to atresia or malposition of vesical end of tube Obstructive lesions must be differentiated from congenital shortening of the ureter *

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TABLE 133—URINARY OBSTRUCTION CAUSES AND DIAGNOSTIC EXAMINATIONS (Continued)

Causes	Suggested Examinations
Kidney (Continued)	
Calculus (p 2314)	Urography (intravenous or retrograde) scout film)
Infection (p 23.3)	Urine Analysis (p .66)
Nephroptosis (p 2?.3)	Urography (intravenous or retrograde) "scout film)
Intratubular obstruction (p 96)	Urine Analysis
Hemoglobin casts (p 10?3)	Urine Analysis
Sulfathiazole and sulfadiazine crystals 3690)	Urine Analysis
Bence-Jones proteose (p 1127)	Urine Analysis
Extra urinary lesions Sacral teratoma, Megacolon (p 18 1) Massive hematocolpos	Scout" film

Beginning at the urethra the following alterations occur in the order mentioned

Urethra

1 Distention
2 Dilatation
3 Diverticulum
4 Urinary extravasation (p 2300)

Bladder

5 Hypertrophy of vesical muscle
6 Trabeculation
7 Diverticula formation
8 Dilatation with
   Incomplete emptying and residual urine
   Complete urinary retention
   Paradoxical incontinence (overflow from distended bladder)

Ureters

9 Hydro-ureter with initial ureteropelvic hypertrophy followed by dilatation elongation angulation and loop formation

Kidneys

10 Hypertrophy and dilatation of pelves and calices (pyelectasis)
11 Hydronephrosis (p 2 71)
12 Pyonephrosis (p 2271)
13 Atrophy of Renal Parenchyma (p 22 0)

The *tempo* of the obstruction has much to do with the symptoms A slowly developing obstruction such as occurs in prostatic hypertrophy produces remarkably few symptoms In routine examination of patients with diseases of the prostate gland the practitioner often encounters a tremendous dilatation of the bladder with which despite the retention of liters of urine the patient presents few or no complaints On the other hand as any normal individual may testify an acute retention of urine is a most painful experience

TABLE 133.—URINARY OBSTRUCTION CAUSES AND DIAGNOSTIC EXAMINATIONS

Causes	Suggested Examinations
Urethra	
Atresia (p 2286)	Inspection
Stricture congenital (p 2286) acquired (p 2299)	Catheterization passage of Sound or Bougie Anterior or Posterior Urethroscopy (p 2247)
Diverticulum congenital (p 2286) acquired	Inspection
Phimosis and Paraphimosis acquired (p 2426) congenital (p 2422)	Inspection
Posterior urethral valves (p 2286)	Anterior or Posterior Urethroscopy (p 2247)
Urethral cysts	Anterior or Posterior Urethroscopy (p 2247)
Hypertrophy of the verumontanum (p 2286)	Anterior or Posterior Urethroscopy (p 2247)
Neoplasm	Anterior or Posterior Urethroscopy (p 2247)
Calculus (p 2319)	Catheterization Anterior or Posterior Urethoscopy (p 2247)
Bladder	
Contracture of vesical neck (p 2286)	Cystoscopy (p 2248)
Cysts (p 2322)	Cystoscopy Urography (intravenous or retrograde) (p 2248)
Diverticula (p 2286)	Cystoscopy Urography (intravenous or retrograde) (p 2248)
Calculus (p 2317)	Cystoscopy Urography (intravenous or retrograde) scout film (p 2251)
Neoplasm (p 2392)	Cystoscopy Urography (intravenous or retrograde) (p 2248)
Neurogenic sphincteric dysfunction (p 2331)	Cystoscopy (p 2248)
Parasites (p 2341)	Urine Analysis (p 306[illegible])
Ureter	
Congenital valves (p 2287)	Urography (intravenous or retrograde) (p 2251)
Strictures (p 2305)	Urography (intravenous or retrograde) (p 2251)
Ureterocele (p 2287)	Cystoscopy (p 2248)
Aberrant vessels (p 2297)	Diagnostic operation
Neoplasm (p 2326)	Urography (intravenous or retrograde) (p 2251)
Calculus (p 2314)	Urography (intravenous or retrograde) scout film (p 2251)
Infection (p 2346)	Urine Analysis catheterization of Ureters (p 2248)
Angulation (p 2305)	Urography (intravenous or retrograde)
Blood clots	Catheterization of Ureters
Neurogenic dysfunction	Urography (intravenous or retrograde)
Kidney	
Aberrant vessels (p 2297)	Diagnostic Operation
Congenital valves at ureteropelvic junction (p 2297)	Urography (intravenous or retrograde)
Congenital polycystic kidneys (p 2291)	Urography (intravenous or retrograde) scout film)
Neoplasms (p 2376)	Urography (intravenous or retrograde)

Hydronephrosis and Pyonephrosis.—The end result of obstructive uropathy is a disorganization of normal renal function and eventual destruction of the renal parenchyma. An increase in intracapsular (intraglomerular) pressure above 80 mm. of water causes glomerular filtration to cease. The calices dilate, the renal papillae become flat and the cortex is thinned progressively until it is transformed into a thin walled hydronephrotic sac. When infection supervenes *pyonephrosis* is produced. In rare instances a sudden complete ureteral obstruction results in renal atrophy without hydronephrosis.

CLINICAL MANIFESTATIONS

The clinical features of urinary obstruction vary with the nature and site of the lesion, the rapidity with which high grade obstruction develops and the presence or absence of infection.



Fig. 537.—Ureteropyelogram in a case of ureterocele with marked hydroureteronephrosis. Patient a woman aged 48. Hematuria of 3 months duration. Examination disclosed a large smooth mass in the region of right ureteral orifice. Latter was found on lateral side of the mass and a catheter passed to kidney. Eight or more ounces of bloody urine were removed.

Infravesical Lesions.—Infravesical lesions quickly cause disturbances in micturition which are sooner or later aggravated by the complicating cystitis. The principal symptoms are *frequency, dysuria, hesitancy, urgency, impaired flow* and *terminal dribbling*. In a child there may be *enuresis*. Such symptoms indicate the presence of a bladder lesion and are the same in a child with a contracted vesical neck as in a male with a hypertrophied prostate.

In long standing obstruction there may be evidences of bilateral hydronephrosis and some degree of renal insufficiency. In the presence of

EFFECTS OF BACKFLOW

Under pathologic conditions a retrograde flow of urine causes serious difficulties and instrumentation which necessarily is made in a retrograde manner, further exposes the tract to the hazard of ascending infection In the male there is the danger of urethroseminal backflow, in both sexes there may be vesico ureteral and pyelorenal retrogression with resultant pressure atrophy hydronephrosis and pyonephrosis

Urethroseminal Backflow —Urethroseminal backflow does not occur in the normal individual With disease of the ejaculatory duct however a reflux may occur to the seminal vesicles and produce severe infection

Vesico ureteral Backflow —The ureterovesical valves prevent regurgitation of the contents of the bladder into the ureters but in disease conditions a reflux may occur This reflux may however be experienced by patients with anatomically sound bladder and ureters during anesthesia in the presence of indwelling ureteral catheters in the knee-chest position or during prolonged voluntary retention of urine Under pathologic conditions the reflux occurs through injury due to stones infection and back pressure or when there are neuromuscular disturbances such as are present in cord bladder



Fig 536 —Pyelogram in a case of congenital bleeding hydronephrosis Patient a man aged 46 had had 3 prolonged attacks of hematuria the last one of 3 months duration With exception of minute hemorrhages in pelvic mucosa no cause for bleeding could be found Nephrectomy successful *

The results of vesico-ureteral backflow are indeed enous since they invite *bilateral ascending infection* (p 2334)

Pyelorenal Backflow —The contents of the renal pelvis may find their way into the *renal* veins This may occur as the result of a break in continuity or from elevation of *intra* ureteral pressure particularly when it is caused by ureteral injections such as are made in retrograde pyelography The pyelovenous reflux occurs more readily in the diseased than in the normal structure

The clinical significance of pyelorenal backflow is the spread of the infectious process to the systemic circulation this produces the so-called urinary fevers" urinary chills and the positive blood cultures seen in obstructive uropathies

Pressure Atrophy —Beyond the changes in pure hydrodynamics obstruction also produces alterations in the kidney proper When intrapelvic pressure exceeds intraglomerular pressure renal function ceases Sooner or later atrophy of the renal parenchyma occurs eventually leading to *renal insufficiency* A neurogenic reflex anuria may occur in an uninvolved kidney as the result of the disturbance in the contralateral involved or obstructed organ

* Herman The Practice of Urology

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Vesico ureteral Backflow —The ureterovesical valves prevent regurgitation of the contents of the bladder into the ureters but in disease conditions a reflux may occur This reflux may however be experienced by patients with anatomically sound bladder and ureters during anesthesia in the presence of indwelling ureteral catheters in the knee-chest position, or during prolonged voluntary retention of urine Under pathologic conditions the reflux occurs through injury due to stones infection and back pressure or when there are neuromuscular disturbances such as are present in cord bladder



Fig 536 —Pyelogram in a case of congenital bleeding hydronephrosis Patient, a man aged 46 had had 3 prolonged attacks of hematuria the last one of 3 months duration With exception of minute hemorrhages in pelvic mucosa no cause for bleeding could be found Nephrectomy successful *

The results of vesico-ureteral backflow are indeed serious since they invite *bilateral ascending infection* (p 2334)

Pyelorenal Backflow —The contents of the renal pelvis may find their way into the *renal* veins This may occur as the result of a break in continuity or from elevation of intra ureteral pressure particularly when it is caused by ureteral injections such as are *made in* retrograde pyelography The pyelovenous reflux occurs more readily in the diseased than in the normal structure

The clinical significance of pyelorenal backflow is the spread of the infectious process to the systemic circulation this produces the so-called urinary fevers urinary *chills" and* the positive blood cultures seen in obstructive uropathies

Pressure Atrophy —Beyond the changes in pure hydrodynamics obstruction also produces *alterations* in the kidney proper When intrapelvic pressure exceeds intraglomerular pressure renal function ceases Sooner or later atrophy of the renal parenchyma occurs eventually *leading to renal insufficiency* A neurogenic reflex anuria may occur in an uninvolved kidney as the result of the disturbance in the contralateral involved or obstructed organ

* Herman The Practice of Urology

nephroptosis to straighten out a ureter plastic procedures and anastomoses for the relief of abnormalities not amenable to the simpler technics and an occasional *nephrectomy* when the diseased organ is hopelessly infected to the jeopardy of the other kidney or the life of the patient

The final decision regarding the surgical procedure necessary is often deferred until the time of operation when the actual condition and the amount of intact renal parenchyma can be visualized

RENAL ISCHEMIA

In addition to its urinary functions the kidney is probably the source of *hormonal* agents intimately concerned with the maintenance of normal blood pressure Experimental and clinical studies indicate that *relatively* minor decreases in renal blood flow are capable of disturbing normal pressor mechanisms with the production of *arterial hypertension*

The Goldblatt Experiments.—Although the relation of renal disease to high blood pressure has been known since the observations of Richard Bright, the role of the kidney was demonstrated convincingly for the first time by Goldblatt (1934) who produced a persistent elevation of blood pressure in dogs by inducing renal ischemia. Mechanical constriction of the main renal artery by means of a clamp was followed by an elevation of blood pressure which *usually but not always returned to normal in four to eight weeks unless the other renal* artery was similarly constricted or the other kidney removed The rapidity and intensity of the blood pressure changes were directly proportional to the degree of renal ischemia

Clinical Observations.—Soon after the production of experimental hypertension clinical counterparts were reported Hypertension was noted in patients with atherosclerotic narrowing of the renal arteries *embolism of the main renal artery* aneurysm of the main renal artery *dissecting and saccular aneurysms of the abdominal aorta with partial occlusion of* the renal artery tumor of one kidney with compression of the renal artery and in unilateral pyelonephritis In the last condition operative "cures" of the arterial hypertension were obtained by *removal of the affected kidney Additional observations indicated that experimental* hydronephrosis led to a decrease in renal blood flow and to hypertension In a series of *patients with essential hypertension hydronephrosis was a common finding*

Renal Ischemia and the Etiology and Pathogenesis of Essential Hypertension.—In view of the relation of hypertension to renal ischemia it seems logical to assume that hypertonus of the renal arterioles is a likely etiologic factor in essential hypertension There is much suggestive evidence that blocking of the renal capillaries and arterioles by inflammatory exudate scar tissue and reflex *vasospasm is productive of hypertension in nephritis pyelonephritis and nephrosclerosis*

The mechanism by which renal ischemia leads to arterial hypertension is not definitely known but the bulk of evidence favors the release by ischemic renal tissue of a pressor substance According to Page the ischemia results in the liberation of a protein (*renin*) which reacts in the blood with an enzyme (*renin activator*) to produce a powerful vasoconstrictor (*angiotonin*) *Angiotonin further decreases renal blood flow and a vicious cycle is established* with a permanent renal anoxia and sustained hypertension

Renal Ischemia and the Treatment of Hypertension.—Several extracts of kidney contain substances capable of reducing renal ischemic hypertension in animals and of causing reversal of the vascular lesions in patients with malignant hypertension These *angiotonin inhibitors* are still highly experimental but their isolation is further suggestive evidence of the important renal pressor depressor system that is commonly disrupted in the nephropathies and uropathies

Surgeons anticipating more tangible physiologic and experimental data have devised operative procedures intended to increase renal blood flow *by interrupting the sympathetic pathway to the renal vessels*

hydronephrosis *pains* in the flanks and upper abdomen are frequent they may be associated with *nausea* and *vomiting* acute paroxysms of *renal colic* (p 2315) denote the passage of stones and clots the *blood pressure* is usually elevated, the *heart* is hypertrophied and there may be *retinal hemorrhages*

Examination of the urine usually reveals *pyuria* and this may be the only positive finding In a child the presence of a persistent pyuria is an indication for a thorough painstaking urologic investigation for a congenital cause of the urinary obstruction

Supravesical Obstruction —*Primary* supravesical obstruction may remain asymptomatic for long periods The lesion is commonly unilateral and compensatory hypertrophy of the uninvolved kidney prevents the onset of renal failure The chief symptoms are *flank pain* the presence of a *tender mass* in the renal region and signs of an acute or chronic *infection* A giant hydronephrotic sac may fill the entire abdomen or the presenting complaints may be cardiovascular due to hypertension Some of those who were previously regarded as subjects of essential hypertension are now known to be affected with a unilateral urinary obstruction amenable to surgical therapy When *secondary cystitis* develops the manifestations are those of the vesical lesion

DIAGNOSIS

Except for the relief of infravesical obstruction from simpler causes the practitioner s function is to refer his patient to the specialist urologist for diagnosis and treatment since both goals may be accomplished with a single manipulation Before the patient is sent to the consultant however the extent of the renal insufficiency is determined by the simpler urinary tests and these are repeated after an interval to determine the progress and tempo of the disturbance

The urologic investigation must be complete It should not be limited to the first abnormal finding since *multiple obstructions* occur and the obstructive uropathy may be reflected through the extent of the urinary tract A minimal set of examinations includes the *scout film intravenous urography pyelography and cystography* with the *determination of residual urine urethrocystoscopy retrograde pyelography and urography cystometry* determination of *neurologic status* studies of *renal function* and examination of specimens by *bacteriologic methods*

TREATMENT

The treatment of blockage is often combined with the diagnostic investigation Strictures are dilated small stones are loosened or crushed and removed, tumors are fulgurated a median lobe prostatic bar is resected and obstructing valves are severed Antibiotic therapy with sulfonamide and/or *streptomycin* or *penicillin* should be employed before and after procedures and tests of renal function are reviewed in the long range therapeutic program

If surgical intervention is required a preparatory period is ordered for the purposes of clearing urinary infection and restoring renal function Thereafter the urologic surgeon proceeds with indicated operative technics which include opening and drainage of the kidney ureter or bladder for the removal of stone division of an aberrant vessel or correction of a

Renal	Following trauma particularly with rupture or hematoma of kidney Hydronephrosis and pyonephrosis best demonstrated by intra venous urography (p 2251) Renal neoplasm with hematuria and deformities of calyces demonstrable by urograms (p 2252) Renal lithiasis with calculi demonstrable by urog raphy and catheterization of the ureters (p 2248) Inflammatory disturbances such as furunculosis, carbuncle perinephritic abscess tuberculosis acute pyelonephritis (pyelitis) or renal tuberculosis with pyuria and deform ities demonstrable by urography (p 2251) Nephroptosis with Dietl s crises of intermittent hydronephrosis (p 2295) Following ligation of the ureter with surgical hydronephrosis.

RENAL INSUFFICIENCY

A thorough understanding of renal insufficiency is essential to the in telligent comprehension and efficient management of the problems created by disorders of the urinary system Renal insufficiency bears the same basic relationship to urinary disorders as cardiac failure does to heart disease The prime therapeutic aims in dealing with diseases of the uri nary system are the preservation and maintenance of the fullest measure of normal renal function

ETIOLOGY

Renal insufficiency is commonly due to extensive destruction of the renal parenchyma an obstructive uropathy or some other interference with the circulatory status of the kidneys In view of the great reserve power of the kidneys a large proportion of the renal parenchyma must be rendered functionless before renal failure results To produce renal in sufficiency in experimental animals in fact more than three fourths of the kidney substance is removed In slowly progressive diseases such as chronic glomerulonephritis or chronic pyelonephritis however an even greater reduction in functioning parenchyma must occur since the unaffected nephrons have a potent tendency to hypertrophy and the involved struc tures possess great powers of regeneration

The Nephropathies—In the various nephropathies there is a consider able variation in the incidence of renal insufficiency It is the common cause of death in *chronic glomerulonephritis* and is one of the frequent modes of exitus during *acute glomerulonephritis* It is uncommon in pa tients with the benign form of essential hypertension but is invariably present and usually fatal in the malignant phase It is seen occasionally in renal amyloidosis and is not infrequent with renal damage caused by drugs particularly *mercury* excessive doses of alkali and the sulfonam ides It is invariably the end stage of chronic renal suppuration

The Uropathies—In the absence of striking anatomic damage renal in sufficiency is produced rapidly by *complete obstruction* to the flow of urine The obstruction leads to a *suspension of urine formation* by reflex spasm or by interference with glomerular filtration and renal blood flow If the

DIFFERENTIAL DIAGNOSIS OF

Lumbar Pain

Lumbar pain is a symptom that is frequently encountered by the practitioner Contrary to the patent medicine advertisements it is only infrequently caused by kidney trouble and is most often musculoskeletal Under no circumstances hould the physician yield to the *temptation of labeling the complaint lumbago a device which consi ts of telling the patient* in Greek what he has already described in English

Lumbar pain is frequently associated with costovertebral tenderne s The latter is apt to be most severe when there is underlying suppuration as in the case of perinephric ab cess or pyonephro is With radiation of lumbar pain to the perineal region or the testis the suggestion is strong that there is involvement of the excretory portion of the urinary tract, as in a renal colic resulting from the passage of a collection of crystals (gravel) or of an actual calculus

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Tegumentary	Herpes zoster with later appearance of characteristic vesicles (p 435)
Skeletomuscular	*Acute and chronic back strain* (p 3063) Osteoarthrosis of the spine with hypertrophic changes in obese middle aged patients (p 2859) Rheumatoid arthritis (Marie Strumpell) of the spine in younger patients with atrophic changes marked vasomotor instability and increase in the erythrocyte sedimentation time (p 2859) Osteomyelitis of the spine with x ray evidences of bone destruction (p 2936) Herniation of the nucleus pulposus often associated with marked limitation of motion and the sciatic syndrome (p 3074) Lesion best demonstrable by contrast radiography (p 3075)
Pleuropulmonary	*With basilar pleuritis pneumonitis* or lung abscess Supplement physical examination with x rays
Pancreatic	On left side with acute hemorrhagic pancreatitis neoplasms or cysts (p 1939) Confirm by laparotomy
Hepatic and Biliary	On right side with biliary colic or cholecystitis and hepatic or subdiaphragmatic absce s (p 1980) Look for icterus Check liver function tests and cholecystograms (p 2000)
Alimentary	Left sided with peptic ulcer particularly penetration or perforation. Look for air bubble under diaphragm (p 1790) With inflammation of an undescended appendix. Consider laparotomy
Circulatory	Renal infarction, particularly in subacute bacterial endocarditis with bacteremia (p 1021) Following thrombosis of renal vein secondary to intravascular disease (p 2330) or the pressure of an *intra abdominal neoplasm*

CONTINUED

POST RENAL	
Obstructive Uropathies	Hydronephrosis pyonephrosis atrophy of renal cortex and pyelo-venous regurgitation Supplement routine urine and blood chemical analyses with urography cystoscopy ureteral catheterization and exploratory nephrotomy or ureterotomy if indicated

block is removed before irreparable injury occurs there is a sufficient return of function to maintain renal capacity at normal levels

An *incomplete obstruction* affecting both sides of the upper urinary tract leads to dilatation and pressure atrophy of the renal parenchyma Under these circumstances the progress of renal insufficiency is slow and *while the functional changes are more apt to be permanent removal of an* incomplete obstruction is frequently attended by a striking improvement in renal function

Prerenal Azotemia—Renal failure is frequently produced by an *interference with the blood* supply to both kidneys This is commonly seen in the many conditions causing peripheral circulatory failure and is termed prerenal azotemia to emphasize the role of extra urinary factors The reduction in renal blood flow is so great that glomerular filtration and urine formation cease The renal factor is apt to be obscured by a general functional depression and death occurs from other causes In the event of a restoration of the peripheral circulation a fairly normal level of renal function is retained

Renal ischemia leading to renal failure may be caused by *congestive heart failure* (p 941) or a *severe anemia* (p 1055) In these conditions there is usually an appreciable degree of antecedent renal damage Their correction by appropriate therapeutic measures often leads to a dramatic restoration of renal function

Renal Ischemia—The renal blood flow may be severely curtailed by spasm and necrosis of the afferent renal arterioles and of the larger interlobular arteries This is seen occasionally in patients with *chronic glomerulonephritis* (p 2379) *chronic pyelonephritis* (p 2356) and *essential hypertension* (p 900) and characterizes the malignant or accelerated phases of these diseases Renal insufficiency develops rapidly and is the common cause of death An interference with renal blood flow by the vascular spasm and blocking of the glomeruli with inflammatory exudate is probably responsible for the occurrence of fatal renal insufficiency and anuria in *acute glomerulonephritis* (p 2373) Vascular interference is operative also in the renal insufficiencies that terminate *periarteritis nodosa* (p 1027) and *acute lupus erythematosus* (p 3399)

Compensated Renal Insufficiency—The compensated phase of renal failure is best seen with slowly progressive types of renal disease It is not associated with any subjective symptoms and may not cause albuminuria cylindruria or any other finding of significance in the routine examination

The compensated stage of renal insufficiency is characterized briefly by a *decrease in maximum urine concentrating power* (hyposthenuria) and an *increase in urine volume* (p 2240) The *polyuria* is attended by *polydipsia* since a moderate restriction of fluids quickly leads to thirst There

DIFFERENTIAL DIAGNOSIS OF

Azotemia

The term azotemia is used to describe retention of nitrogenous products in the blood stream It may or may not be associated with the syndrome of uremia whose mechanism is more fully discussed in another place (p 2275) Basically azotemia may be prerenal, renal or post renal The last of these is encountered in the obstructive uropathies The renal types of azotemia accompany the nephropathies and poisonings Prerenal causes for the accumulation of nitrogenous products are essentially metabolic circulatory and toxic

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

PRERENAL

Obstetric	With hypertensive toxemia of pregnancy associated with elevation of blood pressure albuminuria and edema (p 2638) Bilateral cortical necrosis of the kidneys (p 2330) Consider termination of pregnancy
Metabolic	Dehydration resulting from repeated vomiting protracted diarrhea or excessive sweating Diabetic ketosis with acetonuria, glycosuria and hyperglycemia (p 1251) Crises of Addison s disease with hypotension and pigmentation (p 1275) Alkalosis following repeated vomiting or the excessive administration of alkaline salts as in gastric conditions
Circulatory	Forward failure with shock (p 928) Backward failure with evidences of congestion and edema (p 941) Consider digitalization and use of simpler diuretics
Hemic	Accompanying acute anemias resulting from exsanguination as in massive hemoptysis hematemesis or melena (p 1055) Prepare for transfusion (p 3778)
Hepatic	Cholemias resulting from acute hepatic injuries as in yellow atrophy and infectious hepatitis (p 1979)
Pharmacodynamic	Use of urea as diuretic (p 2260)

RENAL

Nephropathies	Chronic glomerulonephritis associated with hyposthenuria (fixation of specific gravity at level below 1 010) (p 2379) Amyloid nephritis with hepato splenomegaly and positive Congo-red test (p 7) Diffuse vascular diseases of the kidney as in subacute bacterial endocarditis with bacteremia, periarteritis nodosa and diffuse arteritis with cutaneous eruptions (p 1027) Acute glomerulonephritis with albuminuria, hematuria oliguria and cylindruria (p 2373)
Poisonings	Renal lesions produced by sulfonamide crystals hemoglobinuria, mercury poisoning and exposure to poisons such as carbon tetrachloride Obtain history of exposure to poisons Make chemical analyses of urine and search for sulfonamide crystals (p 3690)

CONTINUED

is an increase of neuromuscular irritability as indicated by *fibrillary twitchings* of the voluntary muscles and *hyperactive reflexes* Positive *Chvostek* and *Trousseau signs* (p 723) point to a latent *tetany* and manifest tetany may occur after protracted vomiting The muscle twitchings and tetanic manifestations are related to a decrease in the concentration of ionized calcium in the body fluids *Generalized convulsions are relatively rarely en countered* With hypertensive encephalopathy there may be stiffness of the neck and abnormal reflexes such as the positive *Babinski reflex* (p 3584)

The skin is dry especially in chronic cases and when there has been considerable vomiting it has a distinctive lemon yellow color most pro nounced on the exposed parts of the body skin turgor is poor and there may be a marked degree of cachexia scratch marks are indicative of the extent of the pruritus and petechiae or ecchymoses are found

The *lips* are dry and cracked and there may be a white uremic frost about the mouth The *breath* has a sickening ammoniacal or urinferous odor that pervades the patient s room The *gums* are often diffusely red dened swollen and ulcerated and bleed easily With uremic stomatitis the breath is extremely foul and repulsive and the typical ammoniacal odor is masked beyond recognition Profuse *salivation* is not uncommon Stomatitis and salivation are conspicuous features of mercury poisoning and may be caused by the mercury ion as well as by the renal damage

The respiratory rate is increased *but breathing is commonly quiet and* without stertor even in comatose patients Despite a marked *tachypnea* there may be no subjective sensation of air hunger In the absence of acute infection the *temperature is usually low or normal* but there may be a terminal hyperpyrexia

Evidences of *cardiac failure* are fairly frequent especially in patients with chronic glomerulonephritis and essential hypertension Enlargement of the heart is a constant feature in the hypertensive group Gallop rhythm and pulsus alternans indicate the presence of myocardial weakness In the terminal stages a pericardial friction rub is frequently present as evidence of uremic pericarditis The rub is loud and signifies a grave prognosis It is usually painless but in rare instances is attended by precordial distress

LABORATORY DATA

A decrease in renal function to the point where compensation is no longer possible leads to *retention* in the blood and tissues *of nitrogenous waste products and phenols excessive urinary loss of electrolytes* and a *widespread disturbance of acid base equilibrium* These changes are re flected in the altered chemical composition of the blood and are respon sible for many of the clinical features of the uremic state

Anemia is a constant accompaniment of azotemia but urinary changes beyond those present in the compensated phase are deceptively inconse quential

The Urine —The principal urinary manifestations of azotemia are re flected in the measurements of *volume* and *specific gravity* Additionally there may be a slight *albuminuria* Small numbers of leukocytes erythro cytes and casts may be demonstrable in the sediment but these findings in no wise parallel the intensity of the nephropathy and may mislead the unwary who have been taught to place greatest reliance on such data

is no significant reduction in the excretion of phenol red and no retention of urea or other nitrogenous products in the blood *Urea and creatinine clearance tests* show moderate reduction indicating an impairment of the renal ability to eliminate these substances The kidneys cannot be made to concentrate either by fluid restriction or by the administration of pos terior pituitary extract

Decompensated Renal Insufficiency (Azotemia Uremia)—In the stage of uremia there occurs retention of nitrogenous waste products in the blood The azotemia may come on acutely following acute and complete obstruc tion More frequently however it sets in slowly over a period of months or years and the clinical picture is modified by the inability of the insuffi cient kidney to retain essential electrolytes and assist in the regulation of acid base equilibrium At times in patients with slowly progressive renal disease the acute phase is precipitated by cardiac failure a hemorrhage or an acute intercurrent infection

The increasing severity of the renal functional defect may be followed by repeated studies of renal concentrating power and urea clearance In a sudden anuria decompensation sets in immediately but a latent period of one or even two weeks often intervenes before the onset of uremic manifestations

CLINICAL MANIFESTATIONS

The predominant symptoms of azotemia are those of depression of the central nervous system manifested by *apathy torpor stupor* and *coma* These phenomena may alternate with *periods of excitement* during which the patient is manic and restless and has to be restrained *Headache* is a common complaint of the uremic patient particularly in those with hypertensive cardiovascular renal disease it may be the result of the hypertension toxemia anemia or cerebral anemia

Gastro intestinal symptoms may dominate the clinical picture *Nausea* may be the only complaint for a long period of time it is usually increased by the ingestion of water after a night s sleep *Anorexia* is present to a certain extent in every case and may become so intense that the patient cannot tolerate the sight of food *Vomiting* is common in the early morn ing and after meals it may be toxic the result of increased intracranial pressure or due to local gastric pathology with *uremic ulcerations* and *gastritis* (p 1808) it may become projectile and more or less continuous leading to marked dehydration The presence of nausea anorexia vomit ing and weight loss suggests the diagnosis of an intragastric lesion before the uremic state is recognized

Some patients develop profuse and at times *bloody diarrhea* due to uremic colitis this is often associated with *abdominal cramps* and *ten derness Pruritus* is a common and troublesome symptom especially in chronic azotemia but it may appear as an early feature it is usually gen eralized and may cause intense discomfort as attested by the extensive scratch marks

PHYSICAL FINDINGS

The general appearance of the uremic patient suggests *extreme mental and physical depression* Movements are slow and languid awkward posi tions are commonly assumed and maintained through sheer inertia there

depletion of renal failure is probably an important factor in the production of muscle cramps nausea and vomiting

In contrast to the decrease in serum sodium there may be an increase in serum potassium and magnesium With protracted albuminuria, there is a steady loss of calcium in the urine which may lead to the production of *hypocalcemia* and *tetany* as usually seen in the nephrotic syndrome

Disturbances in Acid Base Equilibrium.—The insufficient kidney loses its highly developed capacity to regulate the selective excretion of acids and bases and thus sacrifices its important function in the maintenance of the acid base equilibrium This defect is indicated by the retention of the acid end products of metabolism notably inorganic phosphate (PO_4) inorganic sulfate and other soluble organic acids In addition the range of urinary reaction is greatly narrowed and there is a decrease in the ability of the kidney to form ammonia an important mechanism for the conservation of fixed base The retention of acids and the loss of fixed base produce a severe acidosis which is responsible for some of the features of the uremic syndrome notably the tachypnea, the dehydration and the onset of cerebral depression and coma The acidosis is indicated by a marked decrease of the carbon dioxide content of the serum The pH of the blood may be decreased and the ability of the red blood corpuscles to take up oxygen is seriously impaired

Not uncommonly an appreciable retention of inorganic phosphate occurs in the absence of a severe acidosis This leads to *hypocalcemia* and favors the onset of neuromuscular irritability The acidosis tends to ward off tetany by increasing calcium ionization but, with the occurrence of a trend toward alkalosis as a result of persistent vomiting *frank tetany* frequently occurs Phosphate retention also causes hyperplasia of the parathyroid glands and an appreciable degree of *hyperparathyroidism* (p 1225)

DIAGNOSIS

It is the duty of the practitioner to recognize renal insufficiency in its compensated phase This is so readily accomplished by simple tests that require only the collection of the specimens and measurements of volume and specific gravity that there would seem little excuse for carelessness The presence of any *potentially nephropathic disturbance* (p 2363) any *uropathy* (p 2234) *cardiovascular affliction* otherwise inexplicable *anemia* or *persistent digestive* or *neurologic* symptoms warrants the necessary and simple investigations which must be repeated at frequent intervals in the suspect In the early phase prevention of further damage is often possible and therapy is eminently satisfactory though lacking in sensational features

The diagnosis of uremia is all too obvious and the results of treatment are in sharp contrast to the ease of recognition The chemical problems of uremia fascinate the academicians of medicine to the exclusion of patient management They simulate the obsession of observers who carefully photograph and study the effects of a block buster while the practitioner intent upon preserving the health and physical integrity of his patient meantime takes off in a fighter plane to attempt a rout of enemy forces

TREATMENT

The treatment of renal insufficiency is directed toward elimination of the causative agency the correction of the deranged metabolic disturbances and symptomatic relief of subjective discomfort

Prophylaxis—Renal insufficiency is of course prevented by the elimination of the significant etiologic factors Prophylactic and curative chemotherapy of the exanthemas and streptococcal infections may accomplish the greatest strides in years to come Patients with *recurrent tonsillitis can*

The *volume* of urine varies with the cause of the renal failure There may be acute suppression (*anuria*) in the uremia of acute glomerulonephritis mercury poisoning obstructive uropathy due to sulfathiazole crystals or calculous anuria Acute suppression requires differentiation from acute retention which may be relieved by catheterization The urine volume is small (*oliguria*) in peripheral circulatory failure dehydration cardiac failure and in the presence of edema In dehydrated patients it usually increases with the forcing of fluids since there is little tendency to retain fluid despite the dry tissues

The *specific gravity* of the urine is low usually within the vicinity of 1 010 This finding is independent of urine volume A high specific gravity may be present in some varieties of prerenal azotemia

The Hemogram—Some degree of anemia is present in every case of uremia and at times it is severe The anemia is usually *hypochromic* and *microcytic* but occasionally it may be *macrocytic* The anemia is due to the toxic depression of the bone marrow possibly by retained phenols A severe anemia may be the presenting symptom in the case of a patient with renal failure resulting from *multiple myeloma* A moderate degree of nitrogen retention and impairment of renal concentrating power are not infrequent in untreated *pernicious anemia*

Retention of Nitrogenous Metabolites.—Azotemia implies that the urea content of the blood is increased There is no definite correlation between the height of the blood urea and the clinical features of uremia Urea retention contributes little to the outward manifestations of the disorder or its downhill course Thus a patient with acute mechanical retention may have a blood urea of 400 mg per 100 cc without symptoms or signs whereas a urea level of 150 mg may be associated with impending coma

In addition to the increase in urea there are accumulations of *uric acid* and *creatinine* in the blood The former may rise from a normal level of 2 to 4 mg per 100 cc to values of more than 30 mg while the *blood creatinine* increases from 1 to 2 mg to values of 15 to 20 mg per 100 cc The hyperuricemia precedes and the creatinemia tends to lag behind the increase in blood urea particularly in complete mechanical obstructions The level of the total *nonprotein nitrogen* is augmented by a slight increase in *amino-acid nitrogen* and an appreciable increase in the *undetermined or rest nitrogen*

Retention of Phenols.—The blood of uremic patients has an increased content of free and conjugated phenols The free phenols include the volatile acids orthocresol and paracresol and the nonvolatile parahydroxybenzoic acid These compounds are formed as a result of processes that involve the deamination decarboxylation and oxidation of the aromatic acids tryptophane tyrosine and phenylalanine by bacterial action on the protein in the intestinal tract Normally these substances are absorbed and detoxified by conjugation with sulfuric and glycuronic acid

The increase in blood phenols parallels the development of the symptoms of uremia more closely than the increase of any other chemical constituent of the blood There is a striking similarity between the symptoms of chronic phenol intoxication and those of uremia In experimental animals the appearance of free phenols in the cerebrospinal fluid marks the onset of uremic coma in uremic patients the degree of cerebral depression is closely correlated with the total phenol content of the blood and high phenol values are of grave prognostic import These data suggest that phenol retention may be the prime cause of uremic toxemia

Excessive Loss of Electrolytes—In *chronic renal insufficiency* the conservative functions of the kidneys suffer quite as much as the secretory functions (Peters) As renal efficiency fails the ability of the kidney to reabsorb sodium becomes impaired with the result that it is wasted in the urine and its concentration falls in the blood and other extracellular fluids Sodium loss is accompanied by a loss of water which however is not as marked as the loss of sodium The result is a state of dehydration with hyponatremia and hypochloremia. This tendency is further enhanced by dietary salt restriction and vomiting The salt

able in the presence of coma or convulsions If sedation must be given *paraldehyde* (p 3845) *chloral* (p 3836) and the *barbiturates* (p 3836) have the least potential for damage The use of *magnesium salts* for convulsive episodes is discussed elsewhere (p 2379)

Peritoneal Irrigation —Following acute renal failure due to parenchymatous injury due to sulfathiazole irrigation of the peritoneal cavity appears to be capable of eliminating uremia

Surgery —Surgical attempts at heroic therapy by *decapsulation* have not had sufficiently encouraging results to warrant continuation of the procedure

be subjected to a tonsillectomy *Foci of suppuration* in the nasal accessory sinuses can be eliminated by appropriate surgical means (p 3038) *Obstructive uropathies* require the prompt attention of the specialist urologist so as to eliminate backflow and its consequences (p 2264) *Urinary tract infections* (p 2234) demand prompt and continued chemotherapy with frequent urinalyses for the early detection of recurrences During the administration of the sulfonamide drugs the precipitation of crystallized material is prevented by an adequate fluid intake and satisfactory alkalinization of the specimen Even the simplest type of *instrumentation* of the urinary tract requires prophylactic chemotherapy and rigid aseptic technic

Patients with digestive disorders must be prevented from overdosage with the *systemic alkalies* Those receiving injections of *mercury* and *bismuth* require repeated urinalyses to detect the earliest possible stage of renal irritation *Urinary calculi and neoplasms* demand early removal

Active Therapy —Once the patient has progressed to the phase of decompensated renal insufficiency, the attention of the practitioner is directed toward treatment of the chemical alterations and attempts to give symptomatic relief No matter how obvious the diagnosis of the nephropathy a *urologic investigation* is indicated for the possible discovery of a mechanical or infectious process which if not of fundamental etiologic significance may have secondary importance Prerenal lesions are sought by determination of the *blood count* and *cardiac efficiency*

Diet Fluids and Salt—The patient with renal insufficiency is given a *full mixed diet* (p 661) *Protein restriction* is neither helpful nor desirable since it leads to deficiency states and asthenia *High protein quotas* are mandatory in the *nephrotic phase* (p 674) Restrictions on *fluids* and *salt* produce or aggravate the manifestations that result from dehydration hyponatremia and hypochloremia (p 675) We favor the administration of *sufficient fluid* to provide *a daily urinary output of 1200 to 1500 cc* *Salt* is used to taste unless there is obvious edema due to chloride retention or hypoproteinemia (p 593) Calcium deficiency is prevented or relieved by an adequate intake of *dairy products* or the *prescription of lime* (p 604) in palatable form Adequate supplies of *vitamins* and *minerals* are assured by the ingestion of convenient preparations which contain daily quotas of these necessary accessory substances (p 620) In the presence of acidosis sodium deficiency is compensated by the oral use of sodium lactate as in the treatment of shock (p 938)

Colonic Irrigation —We favor the use of colon irrigations daily or every second day The elimination of protein from the lower intestinal tract may oppose the retention of phenols in the blood Evacuation of the bowels by saline laxatives or the drastic cathartics depletes and dehydrates the uremic patient

Parenteral Fluid—In the advanced phases of the disease when the cooperation of the patient is no longer possible an *intravenous drip* (p 3775) is established to furnish sufficient quantities of *fluid* salt aminoacid blood calcium or alkalies If there is a suspicion of chloride retention sodium is given in the form of *sodium lactate*

Drugs —Drug therapy is attended with considerable risk *Opiates* particularly cumulate and otherwise inconsequential dosages of them may produce serious poisoning (p 3853) A *lumbar puncture* (p 3781) is advis

When the condition is suspected the urologist has little difficulty in establishing the diagnosis by cystoscopy and pyelography *Treatment* depends on the anatomical cause of the hydronephrosis and the degree of renal destruction and infection that have occurred Sooner or later the hydronephrotic kidney becomes *infected* or *calculi* develop and both conditions coexist eventually *Nephrectomy* in unilateral disease with infection may save the uninvolved kidney

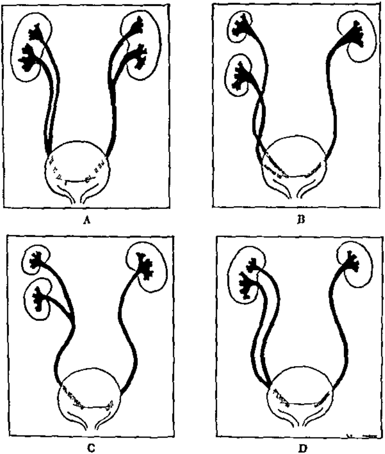


Fig 538—Various types of ureteral duplication *A* Incomplete bilateral duplication Twenty-eight of 38 collected cases (Harpster Brown and Delcher) Division may occur at any level above uretero-vesical junction. *B* Complete unilateral duplication with supernumerary kidney Ten of 382 cases in collected series of Harpster Brown and Delcher *C* Incomplete unilateral duplication with supernumerary kidney Nine of 382 collected cases (Harpster Brown and Delcher) *D* Incomplete unilateral duplication One hundred and twenty four of 382 cases (Harpster Brown and Delcher)

MALFORMATIONS OF THE KIDNEY

The kidney is a very frequent site of congenital anomalies which may involve the number size form position or rotation of the organs They are of paramount importance to the surgeon in his technical approach and often they are the basis for an otherwise inexplicable nephropathy

CHAPTER 108

THE URINARY SYSTEM CONGENITAL MALFORMATIONS

Anomalies of Renal Calices and Pelvis
Malformations of the Kidney
Anomalies of the Blood and Lymphatic Vessels of the Kidney

CONGENITAL malformations are more commonly observed in the urinary tract than in any other system of the body Fully 40 per cent of all pathologic conditions of the kidneys and ureters are due to developmental anomalies which are frequently associated with defects of the reproductive organs An analysis of 150 cases of urologic disease in children disclosed that congenital anomalies were the chief underlying factor

The congenital anomaly is potentially a pathologic entity and is likely to become a surgical problem Anomalies predispose to *urinary stasis infection calculus formation renal insufficiency hypertensive cardiovascular disease* and *malignancy*

The recognition of malformations of the kidney and urinary tract is largely the result of *cystoscopy* and intravenous and retrograde *pyelography* It is the function of the practitioner to refer to his consultant urologist for investigation those of his patients who may suffer from one of the anomalies A certain number of congenital anomalies are clearly visible or palpable on routine examination but most require urograms for their elucidation Their presence is suspected in the presence of otherwise *inexplicable urinary symptoms* and idiopathic uropathies or nephropathies

ANOMALIES OF RENAL CALICES AND PELVIS

Many types of abnormality involve the renal pelvis and calices The latter are often on urograms seen to be aberrant or abnormal in number size and position The renal pelves may be rudimentary double or multiple but in few instances have these anomalies any clinical significance unless they are associated with a congenital hydronephrosis

Congenital Hydronephrosis—Congenital hydronephrosis whether unilateral or bilateral, is secondary to an obstructive lesion in the ureter urethra or bladder and may also result from the pressure of anomalous vessels (p 2297) upon the ureter The congenital hydronephrosis may develop silently or cause early *pain* and intermittent *hematuria* (p 2306)

In most instances patients are in their twenties when the congenital hydronephrosis is recognized The initial symptom is usually an attack of *abdominal pain* without urinary symptoms or abnormal urinary findings There may be *fever* or *irregular chills* of unknown origin a *palpable tumor* may be present in the renal area during the course of the attack Since the difficulty occurs most often on the right side it simulates an *acute appendicitis* (p 1881) The diagnosis is less difficult when the pain is renal in its character and associated with microscopic or gross bleeding

TABLE 134—CONGENITAL MALFORMATIONS OF THE URINARY SYSTEM DIFFERENTIAL FEATURES AND TREATMENT (Continued)

Anomaly	Differential Features	Treatment
Exstrophy of the Bladder	Anterior vesical wall and abdominal wall missing or pe expelled externally usually associated with non union of symphysis epispadias (p 2280) and cryptorchidism (p 2193)	Plastic repair
Persistence of Urachus	Communication with bladder in 1 3 canal reaches to cords umbilicus but urine does not enter	Not required
Urachal Fistulas and Sinuses	At umbilicus with discharge when bladder is full recurrent cystitis (p 2342)	Plastic repair
Urachal Cysts	Canal closed at both ends with midline hypogastric cystic tumor	Resection
Ectopic Openings of Ureters	Into urethra prostate Cowper's glands vagina uterus urachus or bowel (cloaca) cause incontinence (p 2265) enuresis (p 2 65) and ascending infection (p 2334)	Plastic repair
Duplications of Ureters	Bifurcation or with separate ureteral orifices common accidental and asymptomatic finding during urography or cystoscopy	Not required
Congenital Strictures of Ureters	Lead to urinary obstruction (p 2 64)	Dilatation or plastic surgery
Diverticula of Ureter	Rare may be noted by urography	Not required
Megalo-ureter	R[illegible] may be infected	Plastic surgery
Ureterocele	Cystic dilatation of lower end of ureter recognized by cystoscopy may cause retention incontinence infection and stone formation	Endovesical coagulation or plastic repair
Of Renal Calices and Pelvis	See text p 291	
Of Kidney		

Bilateral Renal Agenesis—Bilateral renal agenesis is a rare malformation that is incompatible with life It usually occurs in acephalous monsters

Unilateral Agenesis (Solitary Kidney)—The solitary kidney is usually hypertrophic It is of rare occurrence and there may be no trace of the opposite kidney or ureter there may be two ureteral orifices and a ureter of variable length on the agenetic side or there may be two ureters one attached to a rudimentary kidney

The solitary kidney of itself is of no clinical significance since it may function normally However when it becomes the site of a pathological process that may demand its surgical removal (tuberculosis calculous ob

TABLE 134 —CONGENITAL MALFORMATIONS OF THE URINARY SYSTEM DIFFERENTIAL FEATURES AND TREATMENT

Anomaly	Differential Features	Treatment
Absence of Urethra	No external orifice	
Imperforate Urethra (Atresia)	No external orifice	Meatotomy
Stenosis of Meatus	Usually with phimosis (p 249)	Meatotomy
Stenosis of Urethra	Usually at fossa navicularis detected by urethroscopy	Dilatation and urethrotomy
Disturbances of Urethral Valves	Redundancy of valves at fossa navicularis or valves of posterior urethra small stream enuresis (p 2265) dribbling frequency urinary obstruction (p 2264) residual urine hydronephrosis (p 2284)	Plastic repair early in life
Hypertrophy of Verumontanum	Urinary obstruction as in disturbances of urethral valves	Plastic repair early in life
Hypertrophy and Spasm of Vesical Neck	Urinary obstruction as in disturbances of urethral valves	Plastic repair early in life
Diverticula of Urethra (Urethroceles)	Soft protrusion on penis fills on micturition Dribbling distorted stream	Resection
Duplication of Urethra	With double meatus or openings into glans penis coronal sulcus dorsum of penis prostate or rectum	Plastic repair
Epispadias	Urethral opening on dorsum of penis if at scrotal junction may be bladder exstrophy (p 2287) usually associated with small penis and cryptorchidism (p 2423)	Plastic repair
Hypospadias	Urethral opening on ventral surface of penis usually associated with cryptorchidism (p 2423) and congenital hernias vaginal urethra in female	Plastic repair
Abnormal Opening into Urethra	Channels from rectum and reproductive organs may open into urethra	Plastic repair
Vesical Agenesis	Incompatible with life unless ureters open into urethra or rectum	
Double Bladder	Seen on urography (p 2251) or cystoscopy (p 2248) in investigation of urinary obstruction (p 2264) or infection (p 2334)	Plastic repair
Bladder Diverticula	In region of ureteral orifices or at roof in association with urachus (p 2287) easily infected seen on urography	Plastic repair

TABLE 134.—CONGENITAL MALFORMATIONS OF THE URINARY SYSTEM DIFFERENTIAL FEATURES AND TREATMENT (*Continued*)

Anomaly	Differential Features	Treatment
Exstrophy of the Bladder	Anterior vesical wall and abdominal wall missing urine expelled externally usually associated with non union of symphysis epispadias (p 2256) and cryptorchidism (p 24 3)	Plastic repair
Persistence of Urachus	Communication with bladder in 1 3 canal reaches towards umbilicus but urine does not enter	Not required
Urachal Fistulas and Sinuses	At umbilicus with discharge when bladder is full recurrent cystitis (p 2312)	Plastic repair
Urachal Cysts	Canal closed at both ends with midline hypogastric cystic tumor	Resection
Ectopic Openings of Ureters	Into urethra prostate Cowpers glands vagina, uterus urachus or bowel (cloaca) cause incontinence (p 2265) enuresis (p 2?6) and ascending infection (p 2334)	Plastic repair
Duplications of Ureters	Bifurcation or with separate ureteral orifices common accidental and asymptomatic finding during urography or cystoscopy	Not required
Congenital Strictures of Ureters	Lead to urinary obstruction (p 2 61)	Dilatation or plastic surgery
Diverticula of Ureter	Rare may be noted by urography	Not required
Megalo-ureter	Rare may be infected	Plastic surgery
Ureterocele	Cyst dilatation of lower end of ureter recognized by cystoscopy may cause retention incontinence infection and stone formation	Endovesical coagulation or plastic repair
Of Renal Calices and Pelvis	See text p 2 91	
Of Kidney		

Bilateral Renal Agenesis —Bilateral renal agenesis is a rare malformation that is incompatible with life It usually occurs in acephalous monsters

Unilateral Agenesis (Solitary Kidney) —The solitary kidney is usually hyperplastic It is of rare occurrence and there may be no trace of the opposite kidney or ureter there may be two ureteral orifices and a ureter of variable length on the agenetic side or there may be two ureters one attached to a rudimentary kidney

The solitary kidney of itself is of no clinical significance since it may function normally However when it becomes the site of a pathological process that may demand its surgical removal (tuberculosis calculous ob

struction) failure to diagnose the congenital malformation leads to the death of the patient

The practitioner never permits any surgery of the kidney until the opposite kidney has been demonstrated and its function tested

Supernumerary Kidneys.—Supernumerary kidney with ureteral duplication is a rare abnormality It may be fused to the normal kidney or en

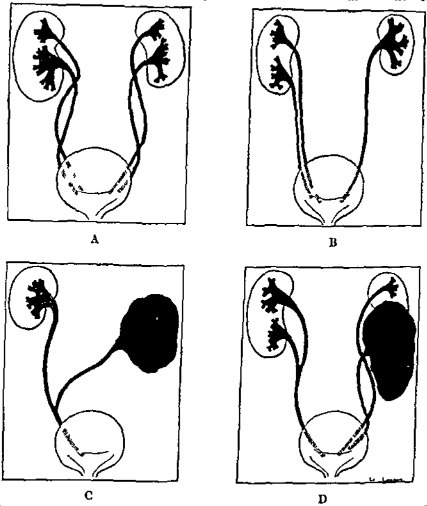


Fig 539 —Various types of ureteral duplication *A* Complete bilateral duplication Forty of 382 collected cases (Harpster Brown and Delcher) *B* Complete unilateral duplication of ureter with fused kidney One hundred and seventy-one of 382 collected cases (Harpster Brown and Delcher) *C* Unilateral ureteral agenesis with duplicated ureter on opposite side one segment leading to a functionless dilated kidney Only 2 recorded cases (1) Braasch (2) Hepburn. *D* Incomplete duplication on right side Complete duplication on left side with pyonephrosis of lower half of kidney (L)

tirely free of it It usually occurs at a lower level than the normal kidney is of irregular outline and smaller size

Double Kidney —The double kidney is the most common congenital mal formation of the upper urinary tract There may be two three or four ureters with two three or four ureteral orifices into the bladder Because of mechanical difficulties double kidneys are more prone than normal kid

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ness to surgical diseases especially *infection calculi hydronephrosis* and *tuberculosis* and usually unless intravenous urography has been per



Fig 540—Complete duplication of left upper urinary tract with pyonephrosis of lower half There is incomplete duplication of right upper tract (see Fig 541) Note small (un infected) upper half and lower pyonephrotic pelvis This plate was made one year before death due to spontaneous rupture of the pyonephrotic sac into the psoas sheath and pleural cavity



Fig 541—Ureteropyelogram in a case of complete duplication of the upper urinary passageways

formed for some other purpose it is only in these conditions that the double kidney is recognized

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The *surgical problem* with double kidney is of particular interest to the urologist A pathological process may be limited to one or more of the com ponents permitting the surgical ablation of the offending portion to the benefit of the healthier half

Fused Kidney —Fusion of the primitive kidneys results in a single renal mass on one side of the vertebral column The lower segment, representing the kidney of the opposite side retains its ureter which crosses the pelvic cavity As with other congenital malformations the fused kidney is par ticularly susceptible to disease and is diagnosed in the course of the radio graphic investigation *Surgery* is hazardous requiring particular care in the preservation of the uninvolved tract

Horseshoe Kidney —The horseshoe kidney encountered once in five hun dred to eight hundred autopsies usually is placed just above the bifurca



Fig 542 —Bilateral pyelogram illustrating characteristic pelvic deformities of horseshoe kidney Pelves are low in position their long axes are directed downward and inward and some of the minor calices are directed inward *

tion of the aorta The *isthmus* which crosses the fourth or fifth lumbar vertebra may contain fibrous tissue or renal parenchyma There is usu ally some associated abnormality in rotation and the arteries are invari ably anomalous both in number and origin Often there are also abnor malities of the ureters which may be single duplicated or crossed The horseshoe kidney is particularly prone to develop *hydronephrosis calculus tuberculosis* or *pyonephrosis*

The presence of the horseshoe kidney is often unsuspected during the life of the individual If the condition is discovered the diagnosis is estab lished in the course of an investigation of *epigastric* or *umbilical pain* or *abdominal distress* The mesially situated mass is felt and its identity is definitely established as the result of *urography* (p 2250) The kidney

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outlines appear close to the vertebral column with obliteration of the psoas margins the pelves are bizarre at times taking on an umbrella like configuration the calices usually point toward one another opposite or over the vertebral column the ureters in their upper course run outward and enter the kidney pelvis at its outer aspect and at times they appear to run behind the pelves

The *treatment* of derangement of the horseshoe kidney is limited to non operative measures since *ill judged removal of the mass is incompatible with survival*

Solitary Serous Cysts of the Kidney—Solitary serous cysts of the kidney are rare They are of no importance unless they become huge and demand exploration If the diagnosis is suspected a posterior approach is advisable *since the cyst wall is thin and if ruptured contaminates the peritoneal cavity* if the operation is performed transabdominally



Fig. 43—Pyelogram illustrating bizarre distortions commonly found in polycystic disease of the kidneys Calices are elongated but widened and terminal cupping largely destroyed Ureter is displaced inward curving around a large cyst at lower pole

The cyst wall requires removal and does not re form nor interfere with the secretory or excretory functioning of the urinary system

Polycystic Disease of the Kidney.—Polycystic renal disease while a congenital malformation is often not recognizable until late in life Large tumors may obstruct labor *leading either to stillbirth or to death of the infant* within the first few days of life

If however an infant with polycystic kidney disease survives the renal parenchyma may be functionally adequate for many years The condition is often observed as a chance finding in an apparently healthy normal individual Later continued compression of the renal parenchyma and its destruction produce evidences of *renal insufficiency* (p 2275) and *hypertension* (p 900)

Pathology—Polycystic renal disease is usually bilateral and is characterized by the presence of numerous diffuse cysts of pea to hazelnut size The cysts are filled with fluid which

may be clear cloudy or of a reddish hue and contains urea uric acid chlorides hippuric acid leucin and albumin The degree of uninvolved normal kidney parenchyma depends upon the stage and extension of polycystic degeneration At the terminal stage the entire kidney substance may become cystic

The kidneys are very much enlarged and appear as bilateral irregular cystic tumors Unilateral polycystic kidney is very rare The degree of polycystic degeneration may vary in both kidneys and there may be associated *pararenal cysts* and *cysts in the liver or pancreas*

The cysts appear to arise as a result of dilatation of the renal tubules The defect is presumably a failure of union between the loop of Henle and the collecting tubules As a result, the secretion from the glomeruli have no outlet and increasing areas of kidney become functionally excluded and cystically degenerated

Some regard polycystic degeneration as a true neoplasm *(cystic adenoma)* but others consider it the result of an *inflammatory nephropapillitis*

Clinical Manifestations—The earliest clinical findings of the polycystic kidneys are irregular bilateral *masses* in the kidney regions Later *abdominal pain* and *hematuria* are observed Occasionally *headache* and manifestations of *renal insufficiency* are the presenting symptoms With increasing destruction of normal tissue evidences of a *renal insufficiency* (p 2275) develop The patient complains of easy fatigue palpitation precordial pain headache or dizziness and the physician notes *elevation of blood pressure* cardiac dilatation or edema

The urine is usually clear and of a low and fixed specific gravity A trace of albumin and casts may be found and there may be isolated white and red blood cells Frank hematuria may be present and this may be associated with renal colic

Polycystic disease is usually associated with complications of one type or another The tumors may be so large as to produce *ileus* and *gastrointestinal disturbances* Infection stone formation hydronephrosis pyonephrosis and malignant degeneration may be superimposed The terminal picture is usually that of uremia apoplectic insult as the result of high blood pressure or cardiac failure

Diagnosis—Polycystic kidney disease has to be differentiated from renal tumor hydronephrosis and chronic nephritis The large irregular cystic masses on both sides and the appearance of the pyelogram aid in establishing the diagnosis

Treatment—The treatment of polycystic kidney disease is most unsatisfactory Infections are treated with streptomycin (p 104) or a *sulfonamide* employing large quantities of water and 2 gm sodium bicarbonate to each gram of the chemotherapeutic agent in order to avoid precipitation within the tubules (p 96) The patient should be urged to lead a life of inactivity and reduce the work of the kidney by utilizing a diet with no more than adequate amounts of protein The complications of hypertension (p 900) and renal insufficiency (p 2275) must be treated symptomatically

The hopelessness of medical therapy has led surgeons to attempt intervention Many have practiced *puncture of the cysts* but this accomplishes nothing of value to the patient If the disease is unilateral or most of the disturbance is limited to a single kidney, a *nephrectomy* of the offending viscus may spare the remaining healthy kidney The decision to perform so radical a procedure should not be made without expert advice and delineation of the risk to the patient or his family

In the face of overwhelming infection or exsanguinating bleeding from a single kidney it may be necessary to chance nephrectomy as a desperation measure in order to preserve or prolong the life of the sufferer In the face of such jeopardy round table consultation is required in order to study the problem from all angles and share responsibility

Congenital Displacement of the Kidney (Renal Dystopia or Ectopia)—Congenital displacement of the kidney results from interference with the normal ascent of the organ Renal dystopia may be unilateral or bilateral and the dystopic kidney is usually located below the pelvic ridge and over the sacro iliac joint The vessels are invariably anomalous

Uncomplicated congenital displacement of the kidney may cause *lower abdominal pain* and *dyspareunia* Ectopic kidneys are predisposed to sur



Fig 344—Pyelogram in a case of ectopic kidney occupying the right iliac fossa. Note that calices are directed inward and that ureter comes from lateral aspect of the pelvis A mass was found which was thought to be an appendiceal abscess Exploration disclosed a normal appendix and an inflamed ectopic kidney (acute pyelonephritis) *

gical lesions especially to hydronephrosis pyelonephritis pyonephrosis and calculus formation It is only when these conditions occur that on urography the displacement is observed Thus the diagnosis is usually made by radiography although often after a mass has been detected on abdominal palpation

Nephroptosis (Floating Kidney)—The normal kidney is held in place by the *perirenal fascia* a firm fibrous connective tissue layer which as it crosses laterally upon the vertebral column to which it is attached envelops the kidney anteriorly and posteriorly The space below the kidney enclosed by the two layers of fascia is usually occupied by a well developed pad of *perirenal fat* which acts as a supportive cushion The perirenal fascia and the perirenal fatty capsule are reinforced by *connective*

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may be clear cloudy or of a reddish hue and contains urea uric acid chlorides hippuric acid leucin and albumin The degree of uninvolved normal kidney parenchyma depends upon the stage and extension of polycystic degeneration At the terminal stage the entire kidney substance may become cystic

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while still recumbent in bed after a night's sleep This specimen should be entirely clear The lad then goes through his normal activities of dressing and breakfasting after which a second specimen is obtained This in the presence of an orthostatic albuminuria is heavy with protein

For Differential Diagnosis, see *Albuminuria* (p 2370)

When the physician has satisfied himself relative to the mechanism of the albuminuria and the functional integrity of the kidney he is justified in explaining the situation to the boy and his parents and advising that the condition be managed by skillful neglect Nothing useful is accomplished by limiting the protein intake of these lads Such dietotherapy may in fact produce a state of hypoproteinemia which combined with the loss of albumin in the urine creates a vicious cycle that interferes with normal growth and development



A B

Fig 545—Secretory urograms in case of nephroptosis showing outward rotation of kidney *A* Patient in prone position *B* Patient in upright position Angle formed by line drawn in mid vertebral axis and another in long axis of superior major calyx is increased as result of rotation Descensus may occur however in absence of rotation

There is no need to limit activity nor eliminate these boys from competitive sports

Corrective postural exercises (p 3757) are of real value and are warmly advocated *Surgical measures* are ill advised since the course of the affliction is benign and the albuminuria disappears as the boy attains full adult growth

INTERMITTENT HYDRONEPHROSIS (DIETL'S CRISIS) —The mobility of the kidney may lead to mechanical alteration in the pedicle When the ureter becomes kinked an intermittent hydronephrosis is produced resulting in acute symptoms Dietl's crisis is characterized by the sudden onset of *renal colic pain in the lumbar region sweating nausea vomiting* and *abdominal distention* The involved kidney may be palpable as an enlarged and tender *mass* With an incomplete obstruction the urine contains albumin casts

tissue trabeculae which extend from the perirenal fascia to the renal capsule Additional factors which tend to hold the kidney in situ are the paravertebral niche which is normally hollowed and the effects of intra abdominal pressure

The normal kidney moves with respiration and the ureters and renal pedicle follow these changes without disturbances of function In most lean patients the lower pole or even the lower half of the kidney particularly on the right side is palpable on deep inspiration

The condition of nephroptosis or floating kidney is said to exist when the kidney can be grasped between the examining fingers thus constituting a *first degree* of mobility When the kidney is freely movable and the examining fingers can be approximated above the upper pole a *second degree* is present Finally, when the kidney falls as low as the iliac fossa there is a *third degree* of ptosis

The factors which contribute to renal mobility are many and varied Undoubtedly the individual habitus is the most important predisposing cause since the condition is far more prevalent in the *ptotic* (p 3490) than the *sthenic individual* (p 3488) More direct causative mechanisms include the disappearance of the perirenal fat relaxation or weakening of the abdominal musculature following pregnancy surgical procedure or wasting disease and rapid weight loss from whatever origin Congenital factors are thought by some to be of considerable importance since the disease is often *familial* and may be associated with an abnormally long pedicle poor development of the perirenal fascia or a malformation of the renal niche

Clinical Manifestations—The majority of patients with nephroptosis do not suffer from any related symptoms The floating kidney is usually an accidental finding in the physical examination Its significance must be evaluated in clinical examples of *orthostatic albuminuria intermittent hydronephrosis* of Dietl and the extrarenal disturbances of those patients who have an associated *anxiety neurosis* or *autonomic imbalance*

Nephroptosis occurs in 20 per cent of women and 2 per cent of males The right kidney alone is movable in approximately 70 per cent of individuals the left alone in but 10 per cent and both kidneys in 20 per cent of the population A generalized *visceroptosis* (p 3489) coexists in only 10 per cent of patients with nephroptosis The frequent finding of the floating kidney requires clinical evaluation in many instances

ORTHOSTATIC ALBUMINURIA —The condition of orthostatic albuminuria occurs most often in lanky boys who show evidences of exceedingly rapid growth The condition is *asymptomatic* until an alarming amount of *albumin* is detected in the urine during the course of some routine examination This laboratory finding produces considerable anxiety unless the mechanism is clearly recognized and demonstrated

In true orthostatic albuminuria the microscopic sediment does not reveal leukocytes erythrocytes or casts The tests of *concentration* and dilution give normal findings (p 2294) There is no retention of *metabolites* in the blood and the excretion of *test dyes* proceeds quite satisfactorily (p 2242) These data reassure the practitioner concerning the function of the kidney and he learns of the pathogenesis of the *albuminuria* by simple urinary tests The patient is requested to void into a bottle

The *aberrant vessels* are of minor importance unless they obstruct the ureter or the ureteropelvic junction in which instance a *hydronephrosis* (p 2284) is produced The presence of the anomaly is suspected when the pyelogram shows a dilatation of the renal pelvis with a sharp convex border abrupt cessation of visualization of the ureter below the ureteropelvic



Fig 546—Ureterogram illustrating ureteral kinking due to anomalous vessels over which ureter is suspended Note that some of the medium has entered dilated pelvis Involved segment when distended from below shows characteristic kinking but under natural conditions the lumen at this point is obliterated and not shown in secretory urograms

junction and trapping in the pelvis Should the hydronephrosis be complicated by urinary infection the whole picture is clouded and may not be clarified until operation or autopsy The anomalous renal vessels are not recognized clinically unless they produce urinary obstruction requiring investigation With astute diagnosis and early surgical intervention the condition may be alleviated by simple *ligation* of the aberrant vessels

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and blood but with complete unilateral occlusion the specimen may be entirely normal

The course of the intermittent hydronephrosis is variable *Infection* may develop producing the urgent picture of *urinary sepsis* (p 2334) Most often the condition abates when the patient reclines and there is a sudden cessation of all symptoms associated with a marked *polyuria* Less often the relief is incomplete and the patient complains of a dull and a continuous discomfort in the lumbar region

Dietl s crisis often provides a confusing clinical picture It may simulate an *acute appendicitis* (p 1881) or *gallbladder colic* (p 2000) The left sided lesions are less difficult of recognition but may give rise to the suspicion that there is present a renal tumor an infarction of the spleen or a pancreatic or ovarian cyst

During the acute attack the diagnosis rests on the clinical findings of the *movable mass* in a ptotic individual Between attacks *intravenous pyelograms* are taken in the upright and recumbent positions The degree of mobility is clearly demonstrable as well as a certain amount of hydronephrosis Often it is possible by radiographic methods to show trapping in the pelvis

For **Differential Diagnosis,** see *Lumbar Pain* (p 2274)

EXTRARENAL SYMPTOMATOLOGY —We are of the belief that the floating kidney does not produce extrarenal symptoms Often the patient is a visceroptotic individual with unstable involuntary nervous system and accompanying neuroses who will seize upon the abnormal finding as justification and explanation for the presenting subjective complaint The physician relieved to discover something tangible agrees with the patient in desperation

Treatment —Nephroptosis rarely requires any significant form of therapy *Abdominal* binders may be employed but support of the kidney is best achieved by the use of *postural exercises* (p 3757) Additionally patients are encouraged to *gain weight* by high calory diets (p 671)

Frequent attacks of intermittent hydronephrosis or the presence of a superimposed infection justify a *nephropexy* which is often performed in association with *decapsulation* The postoperative routine consists if possible of a prolonged *rest cure* with a high calory diet to encourage gain in weight Later postural exercises are ordered and an abdominal binder is prescribed

ANOMALIES OF THE BLOOD AND LYMPHATIC VESSELS OF THE KIDNEY

The renal arteries and veins may vary in their number origin course or penetration The *renal artery* may enter at the upper or the lower pole Two or more vessels may separately enter the hilus or the right and left renal arteries may arise from a single aortic branch The *polar arteries* may take origin from the aorta the renal or some other artery as remote as the external or internal iliac The anomalies of the *renal veins* are equally bizarre They may traverse the area behind the aorta or behind the renal artery There may be supernumerary veins which run a completely abnormal course (retroaortic or retropyelic)

The more severe injuries particularly those of the deeper portions of the urethra and those attended by urinary extravasation call for specialist consultation While awaiting further developments the practitioner initiates chemotherapy and treatment for the attendant *shock* (p 928) The surgical treatment of the urinary extravasation is the province of the specialist as elsewhere described (p 2301) In the event specialist assistance is not available a simple measure of safety is the performance of a *suprapubic cystostomy* (p 2263) with *perineal section for drainage and possible repair of the urethral wound After treatment consists of the passage of sounds in order to prevent the formation of strictures* (p 2299)

INTERNAL INJURIES OF THE URETHRA

Internal injuries of the urethra are quite common They are due to awkward passage of instruments or the insertion of foreign bodies Occasionally a severe chemical burn results from the instillation of a strong chemical through accident or in a bungling attempt at prophylaxis of venereal disease

Perforations of the urethra usually occur in the bulbous or membranous portions The patient complains of severe pain and dysuria and there may be accompanying shock In some instances small quantities of *bloody urine* are passed and there may be complete *retention* or *extravasation Infection* is usually superimposed and *stricture formation* complicates recovery

An attempt to pass a catheter in the presence of an internal urethral injury is attended by risk since a false passage and further trauma may be superinduced

Internal injuries of the urethra are treated in the same manner as *external injuries* (p 2298)

STRICTURES OF THE URETHRA

Stricture of the urethra is an abnormal constriction of the lumen together with a loss of distensibility due to infiltration of the wall secondary to scarring and infection

Etiology —Organic urethral strictures may be *congenital* or *acquired* The former variety has been previously considered (p 2268) The latter usually results from trauma the injection of chemicals or from inflammation most particularly the *gonorrheal infection* The *gonorrheal stricture* which is most commonly seen may be single or multiple and linear angular or tortuous (p 2339)

Pathology —The underlying pathologic cause of most gonorrheal strictures is infection of the *periurethral or bulbourethral glands* Infiltration of the urethral wall occurs and connective tissue is substituted causing subsequent narrowing and loss of distensibility of the structure Although most strictures are situated in the *bulbomembranous portion* of the anterior urethra they are occasionally encountered in the *pendulous portion*

Clinical Manifestations —Presence of the stricture is suspected when the patient has a persistent or recurrent *urethral discharge* in association with an abnormality of the urinary stream such as *frequency interruption dribbling* after urination *delay* in the initiation of micturition *narrowing of the stream* or an *eccentric spray*

The chief significance of the urethral stricture is its threat to the in

CHAPTER 109

THE URINARY SYSTEM INJURIES, ACQUIRED STRUCTURAL DEFECTS AND LITHIASIS

MECHANICAL defects which involve the components of the urinary system are of great clinical significance since they may result in *obstructive phenomena* or *extravasation of urine* Either of these circumstances is productive of widespread infection due to stasis of urine and the inevitable retention

EXTERNAL INJURIES OF THE URETHRA

External injuries of the urethra are more common in the male because of the exposed position and anatomical complexity of the structure The immediate traumatic incident may be a stab wound a gunshot penetration a blow a fall or a fracture involving the pelvis With the female the urethral injury is usually the result of trauma to the pelvic floor during parturition

Clinical Manifestations—In the male the external urethral injury is apparent by inspection since *ecchymosis* and *swelling of the penis and perineum* are observed together with bleeding from the external meatus Attempts to urinate are attended by severe *pain* and an increase in the degree of perineal swelling due to further extravasation of the urine *Chills* and *fever* develop rapidly as the result of urinary sepsis

With rupture of the membranous urethra as the result of a perineal blow or a pelvic fracture there is usually acute *retention of urine* and intense *strangury* with the passage of a few drops of blood

Treatment—The treatment of uncomplicated contusions and lacerations requires only rest in bed and the application of hot compresses Attempts to pass a urethral catheter are often exceedingly hazardous since there is danger of producing a *false passage* and introducing infection Irrigations are best avoided since they are of little benefit and may introduce infectious material On suspicion of urinary extravasation a prophylactic course of streptomycin (p 104) sulfonamide (p 88) or penicillin (p 100) is instituted

rounding tissues Toxemia increases especially if there is urinary retention *Unless treatment is early and vigorous death results from urinary* sepsis with hiccough delirium stupor coma and jaundice

Local examination reveals the phlegmonous process The perineal region is tender tense and edematous Deep fluctuation can be elicited The skin of the penis and scrotum becomes infiltrated and pits on pressure The testes and cord structures are significantly not involved

The *chronic peri urethral infiltrations* follow the subsidence of the acute inflammations A slowly developing firm nodule or abscess is observed The latter often ruptures and produces a *urinary fistula* Exacerbations are observed Each results in the formation of more dense fibrous tissue infiltration along the spongiosum and perineum Finally penis and scrotum become brawny and thickened as the result of lymphangitic change Eventually the infection involves the upper urinary tracts and leads to sepsis or renal insufficiency

Diagnosis —The patient with peri urethral infiltrations or abscess is referred to the consulting urologist The most complete study is required including visual examinations and delineation of the fistula by the injection of *radiopaque substances* (p 2250) A *biopsy* of the fistulous tract is made with particular attention to the demonstration of tuberculous or carcinomatous tissue

Treatment — *Acute peri urethral abscess* with urinary extravasation has a mortality rate that approaches 50 per cent In consequence specialist consultation is required and emergency operative procedures are indicated The urinary stream is diverted by a *suprapubic cystostomy* by external *urethrotomy* or by the introduction of an *indwelling urethral catheter* *Multiple incisions* are made into the infiltrated tissue Through and through drainage is established to allow escape of the extravasated urine Wet dressings of 1 4000 potassium permanganate are applied to the wound

The *supportive measures* consist of continuous *intravenous infusions* of saline and glucose *Transfusions* of whole blood are indicated in the face of an anemia or shock Tetanus and anaerobic *antitoxin* (p 297) are introduced into the drip and *chemotherapy* is supplied with the sulfonamides and streptomycin (p 104) or penicillin (p 106)

After the acute phase of inflammation has subsided the initial cause is sought A stricture is progressively dilated and plastic surgery may be required to remove an obstruction and close a persistent urinary fistula

Chronic peri urethral infiltrations require wide incision of the sclerotic tissues with resection of the involved portion of the urethra and a urethroplasty

INJURIES TO THE URINARY BLADDER

The common bladder injuries include contusions perforations and rupture of the viscus

Etiology.—*Contusions* of the urinary bladder are usually the result of falls blows in the lower abdomen or compression by the fetal head during parturition They are of little clinical significance unless attended by shock or hemorrhage *Perforating wounds* are commonly inflicted from without by bullets shell fragments bayonets and knives Occasionally the viscus is injured during operative procedures such as herniorrhaphy

tegrity of the seminal tract and kidneys Infection may spread and produce *peri urethral abscess prostatitis* with abscess, *seminal vesiculitis epididymitis* or *orchitis* Ascending involvement of the urinary tract may result in *hydronephrosis* or *pyonephrosis*

Less often the stricture causes local complications such as the formation of *diverticula* of the urethra *rupture* with extravasation of urine or the formation of *fistulas* of the bladder and upper urinary tract An occasional *urethral hemorrhage* is experienced

Treatment—The *definitive diagnosis* and *treatment* of the urethral stricture require the passage of a diagnostic instrument such as a catheter bougie sound or endoscope Since instrumentation is not without danger patients are prepared by streptomycin or penicillin injections or by oral sulfonamide (p 88) bland urethral irrigations and the instillation of oil Active nonoperative therapy consists of *dilatation* with filiforms followed by the use of graduated bougies sounds and dilators Surgical intervention may involve the performance of a meatotomy, internal urethrotomy external urethrotomy or cystostomy

Whereas urethral stricture is generally regarded as a disease of the male it may also occur as a congenital anomaly *in the female* and produce ascending pyelonephritis in young girls (p 2353) Acquired strictures in the female may follow *gonorrhea* or *lymphopathia venereum* Management is simplified by the shortness of the passage and the ease with which instrumentation can be performed

PERI URETHRAL EXTRAVASATION AND PERI-URETHRAL ABSCESS

Peri urethral urinary extravasation and peri urethral abscess may arise from injury and ulceration of the urethral mucous membrane at the site of a stricture from acute inflammation of the urethra Littre s glands Cowper s gland or the prostate gland and from trauma incidental to therapeutic or diagnostic instrumentation Less frequently the lesion is produced by a degenerating neoplasm involving the urethra or a chronic inflammation such as tuberculosis

Etiology and Pathology—The mere presence of urine in the tissues results only in the production of *edema* which is quickly resorbed without permanent damage The additional presence of bacteria, particularly *B coli B proteus* streptococci staphylococci gonococci or the anaerobes produces a circumscribed or diffuse inflammatory process which may eventuate in abscess formation

With involvement initiating from the *anterior portion* of the urethra the extravasation is confined to the shaft of the penis and is limited by Buck s fascia Involvement of the *posterior portion* results in a spread into Colles pouch to involve penis scrotum perineum groin the lower abdominal walls and thighs Occasionally the inflammatory process surrounds the rectum and gravitates to the anal region

Clinical Manifestations—The *acute peri urethral infiltrations* are heralded by the onset of a high *fever* and *localized pain* Chills malaise and extreme toxemia may so dominate the picture that the local symptoms and signs are overlooked temporarily With rupture of the infiltration and the formation of abscess a diffuse *urinary extravasation* develops spreads rapidly and leaves gangrene of the subcutaneous tissues in its wake The initial tender swelling spreads in the midline of the perineum to the sur

o erfilled Th site of the rupture is the posterior aspect of the fundus the weakest pc of the viscus *Extraperitoneal rupture* is apt to occur at the trigone when the bladc partially filled and in conjunction with fractures of the pelvis

Clinical Manifestations —Wounds of the bladder are associated with found *shock* which obscures the local signs and contributes to the mortality The intraperitoneal variety is more severe and is likely t accompanied by *peritonitis*

Intraperitoneal Rupture —Intraperitoneal wounds and rupture are sociated with *hypogastric pain tenderness* and *urgency* with inabilit void more than a few drops of grossly *bloody urine* As the urine enters peritoneal cavity the chemical peritonitis produces general abdom rigidity and tenderness with nausea and vomiting Secondary infectio the peritoneum is common

Extraperitoneal Rupture —The extraperitoneal type is clinically la *until considerable urine has extravasated into the surrounding tissues* i usually localized to the suprapubic region but may be referred to perineum penis rectum or lower extremities The urine may be bl stained or there may be complete retention The extravasated urine progress upward behind the posterior parietal peritoneum and give ris a mass in one or both flanks or it may dissect down under Poupart s l ment into the thigh to reach the scrotum

Diagnosis and Treatment —The presence of bladder perforation or ture is suspected with lower abdominal injuries associated with hypo tric pain the passage of small amounts of bloody urine or complete re tion and the signs of a suprapubic or retrovesical mass or of diffuse p onitis

The diagnosis is confirmed by the introduction and withdrawal catheter of a measured quantity of sterile fluid Failure to recover amount equal to the volume introduced is sufficient evidence to war immediate surgical intervention as soon as shock is controlled and che therapy (p 106) has been begun The urological consultant is summo if possible to repair the injury and divert the urinary stream Late c plications after successful closure are infection urolithiasis fistula for tion pyelonephritis and renal insufficiency

HERNIATION OF THE BLADDER

Herniation of the bladder may occur through the urethra vagina the inguinal or femoral rings

Extroversion —Extroversion or prolapse of the bladder through the thra is rare and occurs mostly in the female Its management is the p ince of the specialist

Cystocele —Cystocele occasionally occurs at the time of or follow *childbirth* It is due to an injury of the anterior vaginal wall and is ally associated with *rectocele* (p 2536) resulting from a similar disturba of the posterior vaginal wall

Cystocele is recognized by vaginal inspection and palpation while patient strains or stands upright The anterior vaginal wall bulges into vagina and may appear externally through the introitus

The *management* of cystocele is discussed elsewhere in greater de (p 2537)

hysterectomy colonic resection cystoscopy lithopaxy fulguration of bladder or transurethral prostatic resection

Rupture of the bladder is favored by processes which distend and weaken the wall such as simple vesical overfilling as commonly encountered in acute alcoholism urinary retention and the organic changes inci

DIFFERENTIAL DIAGNOSIS OF

Pain in Hypogastrium

The problem of hypogastric pain is usually resolved by the physical examination since the parts are easily palpable and often are accessible to visual exploration by cystoscopy sigmoidoscopy and vaginoscopy

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	Cystitis or inflammations of urachus Examine umbilicus Inflammation of Meckel's diverticulum, revealed at operation
Male Reproductive	Prostatitis and seminal vesiculitis (p 2467) Examine structures by rectum and obtain urethral smear (p 50)
Gynecologic	Dysmenorrhea (p 2561) Abortion or onset of labor Ruptured ectopic pregnancy (p 2657) Retention or separation of membranes (p 2665) Endocervicitis or endometritis (p 2607) Salpingo-oophoritis or pelvic peritonitis (p 2608) Supplement abdominal palpation with rectal and vaginal examinations (p 3648) Perform vaginoscopy (p 3647) for evidences of cervical inflammation, neoplasm or bleeding Note increased erythrocyte sedimentation rate in infections particularly salpingitis (p 3693)
Urinary	Distention or rupture of bladder (p 2302) Retention of urine (p 2264) Cystitis (p. 2342) Vesical or ureteral calculi (p 2317) Obtain urine by catheterization (p 2236) Look for erythrocytes leukocytes and crystals in sediment (p 3680) Get scout film for radiopaque calculi and prepare for cystogram (p 2332) Refer to urologist for cystoscopy
Intestinal	Gastrovisceroptosis Enterocolitis (belly ache) and spasmosis Acute appendicitis (p 1881) Diverticulitis of sigmoid (p 1868) Obstructions particularly volvulus (p 1875) and intussusception (p 1876) Note rectal findings Consider surgical consultation and exploratory laparotomy in suspected appendicitis

dental to inflammation atony trabeculation and diverticulum formation A weakened bladder wall may rupture spontaneously from muscular effort instrumentation as a complication of pelvic fractures or from the impact of the steering wheel on the hypogastrium in automobile accidents

Pathology—Perforation and rupture of the bladder may be intra or extraperitoneal *Intraperitoneal perforation* the more serious and common type occurs when the bladder is

STRICTURES AND KINKS OF THE URETER

Ureteral strictures are congenital or acquired The anatomical points of ureteral narrowing occur juxtavesically at the crossing of the iliac vessels and at the pyelo-ureteral and vesico-ureteral junctures (p 2296) These points of narrowing may be sufficiently exaggerated to cause obstruction and hydro-ureter

Acquired ureteral strictures are usually traumatic They may follow erosion by a calculus or trauma during a surgical procedure The view that primary ureteral stricture results from focal infection finds no corroboration in clinical practice Stricture formation however may occur from extension of infection of the female genitalia (p 2584) or from malignant infiltration from a carcinoma of the cervix uteri (p 2551)



Fig 547—Pyelogram in comparatively early case of hydronephrosis due to upper ureteral stricture Note dilatation of ureter just below ureteropelvic junction In certain cases of this type successful plastic repair of deformity may be done

Kinking or angularity of the ureter is noted where the ureter crosses the iliac or uterine vessels or the vas deferens It may also be due to *nephroptosis* (p 2293) and result in *Dietl s crisis* (p 2295)

Strictures of the ureter are difficult to overcome Instrumental dilatation is attempted Failing relief by this method plastic repair or a nephrectomy is required

INJURIES TO THE KIDNEY

Renal injuries include contusion laceration perforation and traumatic rupture From a pathological standpoint they are *penetrating* or *subparietal* with or without a *perirenal hematoma* Penetrating injuries common in war are always attended by injury to other organs and tissues The

Herniation Through the Inguinal or Femoral Rings—True herniation of the bladder occurs through the inguinal or femoral rings The management consists in repair of the hernial sac (p 3093)

FOREIGN BODIES IN THE BLADDER

Foreign bodies are occasionally introduced through the female urethra and into the urinary bladder during masturbation (p 2534) Less often extraneous substances enter as the result of gunshot wounds fractures of the pelvic bones or the breaking off of a catheter during endourethral or endovesical procedures The presence of the foreign body invites infection and stone formation

Clinical Manifestations—The foreign body may remain latent within the bladder for a variable period of time Eventually, a *cystitis* (p 2342) develops with painful urination frequency urgency and the presence of blood and pus in the specimen Less frequently there are noted terminal *dysuria* or *hematuria* intermittence and interruption or *obstruction* of the urinary flow Penetration of the wall of the bladder by the foreign body produces a phlegmonous inflammation of the viscus and the perivesical tissues with symptoms which simulate rupture of the bladder

Radiopaque foreign bodies such as hairpins, needles and lead pencils are visible upon diagnostic *radiography* In other instances the material is not recognized until the patient is investigated by *cystoscopy*

Treatment—If it is at all possible the foreign body is removed by *trans cystoscopic methods* using a grasping forceps If non operative measures are unsuccessful a *suprapubic cystostomy* (p 2263) is performed for which the patient is first prepared by a course of prophylactic chemotherapy with the sulfonamides and streptomycin (p 104) or penicillin (p 106)

INJURIES TO THE URETER

The majority of ureteral injuries are accidents produced during surgical procedures The ureter may be clamped and divided during operations in volving the uterus adnexa bladder or colon Accidental surgical ligation leads progressively to ureteral stenosis hydronephrosis pyonephrosis atro phy of the kidney and ureterovaginal ureterocolonic or ureterorectal fis tulas

Injury to the ureter also results from a blunt force struck from with out by penetrating stab or gunshot wounds and during instrumental de livery in a difficult labor At times an impacted ureteral calculus ulcerates through the wall and leads to urinary extravasation with the formation of a peri ureteral abscess

Clinical Manifestations—*Unilateral ligation* of a ureter may be asympto matic In most instances subsequent *lumbar pain* or *urinary infection* of the occluded side suggests the diagnosis There may be the findings of urinary extravasation such as a mass in the flank diffuse abdominal pain rigidity and the development of fistulas *Bilateral ligation* produces anuria and uremia unless promptly relieved

Treatment—Injury to the ureter requires immediate repair at the time of the accident In a reasonable number of accidents *nephrectomy* is indi cated sooner or later

Circulatory	Backward failure with chronic passive congestion (p 941) Following infarction of renal artery particularly in subacute bacterial endocarditis (p 1021) Thrombosis of the renal vein in intravascular disturbances (p 2330) Periarteritis nodosa with diffuse vascular disturbances and eosinophilia (p 1027) Acute lupus erythematosus with characteristic eruption (p 3399). Streptococcemia and staphylococcemia with positive blood cultures (p 53)
Gynecologic	Avoid error of mistaking admixture of menstrual or uterine blood for hematuria. Endometriosis associated with uterine fixation and dysmenorrhea (p 2558) Salpingitis and pelvic peritonitis with contiguous inflammation of ureter Note pelvic findings
Male Reproductive	Infections neoplasms and calculi of prostate and seminal vesicles (p 2467) Make rectal examinations and get x rays
Urethral	Following instrumentation with catheter sound or bougie Inflammations neoplasms and calculi revealed by urethroscopy (p 2247)
Cystic	Sudden emptying of overdistended bladder Following instrumentation particularly catheterization and cystoscopy Neoplasms foreign bodies inflammations varicosities calculi parasitic invasions particularly schistosomiasis and crystalluria particularly oxaluria Examine urine microscopically for crystals ova and calculi (p 3681) Concentrate and make carbolfuchsin stain for acid fast bacilli (p 49) Inject catheterized specimen into guinea pig for tubercle bacilli (p 63) Refer to specialist for cystoscopy and x rays Obtain specimen for biopsy
Renal	Obtain bladder and ureteral specimens during active bleeding in order to demonstrate site or side of lesion (p 2248) Following trauma Congenital and acquired hydronephroses demonstrable by urography (p 2251) Polycystic kidney disease associated with bilateral enlargement of the kidney and hypertension (p 2291) Perinephric abscess with obliteration of psoas by x ray (p 2350) Nephropathies *particularly focal interstitial nephritis* diffuse acute glomerulitis tubular nephrosis and acute glomerulonephritis (p 2362) Nephrolithiasis demonstrable by x rays and urograms (p 2311) Neoplasms particularly malignancies with deformities in urogram (p 2326) Nonspecific and tuberculous pyelonephritis and pyonephrosis (p 2347)
Pelvic	Accompanying inflammations of structures impinging on ureter as in appendicitis salpingitis and diverticulitis Misleading finding must not postpone laparotomy particularly in appendicitis (p 1881)

DIFFERENTIAL DIAGNOSIS OF

Hematuria and Hemoglobinuria

The important symptoms of hematuria and hemoglobinuria require meticulous investigation. Hematuria in which there are demonstrable erythrocytes in the urinary sediment, may be microscopic or gross Hematuria may be initial in micturition under which circumstance there is usually involvement of the anterior urethra or it may be terminal most often from lesions of the prostate and seminal vesicles Hematuria may be painless or painful The painless variety is the more ominous since it often suggests ulceration due to a malignant neoplasm or a chronic infectious disease particularly tuberculosis

The hemoglobinurias are characterized by the appearance in the voided specimen, of blood pigments but no demonstrable erythrocytes In the majority of instances hemoglobinuria is the result of intravascular hemolysis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

In the Newborn	Hemorrhagic disease due to vitamin K deficiency Note response to menadione (p 1113) Erythroblastosis foetalis with characteristic hemogram and disturbances of Rh factor in maternal and paternal bloods (p 1067) Neonatal syphilis with positive serology (p 2787) Hemoglobinuria with rapidly progressive anemia in Lederer s syndrome (p 1073)
Physical and Chemical Injuries	Hemoglobinuria due to long marches or to cold latter often paroxysmal and associated with syphilis Get Wassermann and Donath Landsteiner tests (p 1075) Nocturnal hemoglobinuria in Micheli Marchiafava syndrome Myoglobinuria with ischemic muscle necrosis
Pharmacologic and Toxic	Hematuria with precipitation of sulfonamide crystals (p 2306) Hemoglobinuria after exposure to phenol turpentine cantharides, quinine and the sulfonamides Also with mushroom poisoning snake and spider bites favism and bartonellosis
Generalized Infections	Paroxysmal hemoglobinuria in syphilis with positive Wassermann and Donath Landsteiner reaction (p 1075) Blackwater fever in malaria (p 514) Hematuria in yellow fever with jaundice and history of epidemic (p 477) Hematuria in subacute bacterial endocarditis with bacteremia (p 1021)
Blood Dyscrasias	Hematuria and hemoglobinuria following transfusion of incompatible blood (p 1074) or iso-agglutination as in erythroblastosis foetalis (p 1067) Hemoglobinuria in hemolytic anemias (p 1060) Hematuria in hemophilia thrombocytopenic purpura, leukemia scurvy hemorrhagic capillary toxicosis vitamin K deficiency and polycythemia vera Get hemogram (p 3704) and bleeding and coagulation times (p 3706) Note therapeutic responses to cevitamic acid, menadione and splenectomy (p 1053)

CONTINUED

in the event that nephrectomy is obligatory? The intravenous urogram usually gives a satisfactory answer to both these questions

Treatment—The significance and consequences of renal injury necessitate consultation with the specialist Penetrating wounds require explora

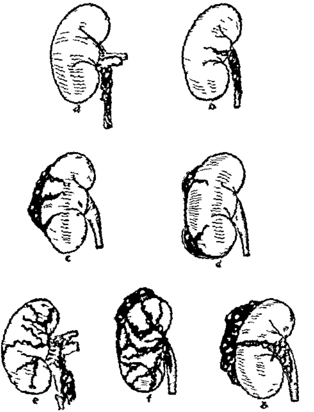


Fig 548—Schematic drawing illustrating various types of renal injuries *a* Rupture of perureteral vessels with periureteral hematoma There may be slight hematuria in the event of associated injury to ureteral walls It is probable that hydronephrosis is due to obstructive adhesions as a frequent sequel of this injury *b* Single line (short) of parenchymal rupture extending into true pelvis with hemorrhage into and around the pelvis *c* Incomplete external rupture involving capsule with perirenal hematoma *d* Incomplete external rupture with intact capsule and subcapsular hematoma *e* Widespread tearing of kidney with complete or partial severance of ureter or vascular pedicle or both *f* Extensive maceration of kidney without injury to ureter or vessels *g* Complete bisection of kidney the tear extending into the pelvis There are of course many minor variations of the foregoing encountered Uncomplicated rupture of the pelvis is rare

tion but not until shock and hemorrhage have been controlled through an intravenous drip of saline glucose plasma and blood

With subparietal trauma and perirenal hematomas *conservative treatment* is sometimes indicated if there is a slight degree of hemorrhage and no evidence of infection or intraperitoneal complication A relatively normal pyelogram argues against a complete or severe tear of the kidney

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subparietal wound for the most part, is a localized rupture of the renal cortex from a fall blow or concussion

Penetrating Wounds—Penetrating wounds may involve parenchyma or hilum They occur from bullets shell fragments bayonets and knives and are rare in civilian practice *Parenchymal wounds* may cause destruction of either pole or of the whole kidney They may involve the calices but urinary extravasation is rare unless the renal pelvis is involved *Hilar wounds* are complicated by rupture of the renal arteries with severe internal hemorrhage Peritoneal tears are usually present

Subparietal Wounds—Subparietal wounds are usually due to a blow such as kneeing in a football game a crushing abdominal injury or a punch during a prizefight The external force may be direct through the abdominal wall or indirect compressing the ribs or vertebral column against the kidney The resulting injury may be a *contusion laceration* or rupture *Rupture* is favored by the presence of an antecedent hydronephrosis The degree of injury varies from a capsular tear to a complete separation of the organ from the pedicle In some instances, the upper or lower pole is torn away

Perirenal Hematoma—The lumbar trauma may result in a subcapsular collection of blood or hemorrhage into the perirenal tissues (perirenal hematoma) leading to the formation of a perirenal cyst or abscess

Clinical Manifestations—The clinical manifestations of renal trauma are general and local They vary with the severity of the injury *Shock* is usually present and is severe in the presence of an associated injury to the thorax abdominal viscera or spine

The local injury is suggested by *tenderness and muscle rigidity* of the abdominal wall and costovertebral region of the involved side Extensive perirenal bleeding produces a *large mass in the flank* Signs of diffuse peritoneal irritation are often present and indicate a concomitant injury to adjacent viscera Abdominal distention may come on rapidly

Hematuria is frequently present and may vary from a few cells which are visible on microscopy to a massive hemorrhage It may be intermittent or delayed Hematuria may be misleadingly absent in subcapsular injuries or if the ureter is cut across or blocked *Urinary retention* is common with a concomitant cord injury The passage of blood clots gives rise to attacks of *renal colic* Delayed hemorrhage two or three weeks after the injury may be severe even in instances where the trauma was slight It is often accompanied by large intravesical clots

Diagnosis—The diagnosis of renal injury is made on the basis of the history and physical findings but should be corroborated by an immediate radiograph An abdominal *scout film* (p 2250) may show a hazy renal outline obliteration of the psoas margin and lumbar scoliosis with the convexity away from the injury The *intravenous pyelogram* (p 2251) is of great assistance if the condition of the patient permits the procedure It aids in locating the extent of the injury and the presence and function of the opposite kidney in the event that nephrectomy is indicated *Cystoscopy ureteral catheterization and retrograde pyelography are dangerous* in shock and when there is a complicating fracture As emphasized by Scholl The only immediate questions to be settled are Is operative intervention imperative and is the opposite kidney capable of sustaining life

URINARY LITHIASIS

Calculi in the urinary tract constitute a major problem in urologic practice Despite exhaustive studies of the factors involved in stone formation the causes for their production are unknown and prevention is difficult Unless they are recognized early and removed they lead to obstruction and infection of the urinary tract and eventually to extensive renal destruction

ETIOLOGY

The principal factors predisposing to stone formation are infection, stasis and metabolic disorders

Infection with Stasis.—Urinary calculi are commonly encountered with stasis of infected urine There is a high incidence of vesical calculi in a ed males with prostatic obstruction and vesical diverticula Renal calculi are frequent in the presence of congenital anomalies of the kidney An ulcerative papillitis with encrustation by urinary salts is often the starting point of renal stone formation and viable bacteria may be obtained from the nucleus of a urinary calculus

Bacterial infection leads to urolithiasis by changing the physicochemical state of the urine and by producing local areas of necrosis and inflammation which act as primary sites of urine salt precipitation Colon bacillus infections make the urine acid and lead to the deposition of uric acid or calcium oxalate Pyogenic cocci and *B proteus* render the urine alkaline and cause the deposition of phosphates

Metabolic Factors—Metabolic factors favor the formation of urinary calculi by increasing the urinary concentration of stone-forming substances

Increased Excretion of Calcium and Phosphorus—The increased excretion of calcium and phosphorus in patients with *hyperparathyroidism* is closely related to the high incidence of *nephrocalcinosis* and *urolithiasis* in this condition Calculi are not uncommon in association with other disorders characterized by *o t oporosis* and an increased excretion of calcium and phosphorus These include *osteomyelitis chronic nfectious arthritis* and *fractures* of the lower extremities requiring long periods of immobilization The disuse of the skeleton is accompanied by rar faction of bone and an increased excretion of bone-forming minerals In bedridden patients urinary tasis also is favored by the prolon ed maintenance of the recumbent pos t on

Increased Excretion of Uric Acid—The excess ve urinary excretion of uric acid is often attended by the format on of urate and uric acid calculi Normally urates remain in solution in the urine but an inc eased concentration of acid phosphates may fix the basic radical of th s lt and precip tate free uric acid Uric acid showe s" caus ng *renal colic* and acting as foci for calculus formation are not uncommonly seen in normal individuals on an *acid ash d et* composed ch efly of bread and meat Uric stones are seen in patients with *ch onic myeloid l ukemia* and *polycythemia vera* in which increased urinary excretions of uric acid are common

Gout (p 2567) bears an interesting but obscure relation to urinary calculi There is a h gh inc dence of stones in patients with gout and *enal colic* may p ecede the recognition of the disease The reason for this association is not known but t may be related to the frequent formation of small urate deposits in the renal parenchyma

Cystinuria—Cystinuria is a rare metabolic disorder in which ? per cent of cas s are associated with urolithiasis Cystine is an amino-acid which occurs in small amounts in normal urine In cystinuric patients it appears in excess in the urine the result e ther of a lowering of th r nal threshold for cystine or of some defect in the intermediary metabolism Infection *nd stas s predispose to stone formation in these cases* but as a rule the condit on is asymptomatic until urinary calculi have formed

D et—D et plays an important but complex role in calculus formation and may account for geograph cal va iat ons in the incidence of urolithiasis In general stone formation is to be expect d where there is a low standard of living *t tamin deficiency* and a p edominantly vegetarian alkaline-ash diet In areas where such living conditions prevail, su h as India As a M nor and South China urolithiasis *s most commonly found ves cal calculus,* while e in America and Europe is on of the commonest d so ders of ch ldhood in Ind a Rats fed on diets deficient n v tam n A frequently have r nal calculi

Drugs—The urinary excretion of h gh concentrat ons of the acetyl der vatives of *sulfapyrid ne* and *sulfathiazole* (p 88) often leads to gravel and calculus format on due to the

Under these circumstances bed rest of two or three weeks is advisable because of the possibility of remittent bleeding At the time of discharge from the hospital there must be no evidence of oozing perirenal infection or tumefaction

Operative interference is required when there is severe loss of blood rapidly increasing tumefaction or evidence of an associated intraperitoneal injury Shock and hemorrhage are combated as previously noted An es sential precaution is the establishment of the presence of a contralateral healthy kidney in the event that a nephrectomy is necessitated The opera tive procedure with a less severe tear may be limited to suture with pack ing and drainage More severe injuries require nephrectomy (p 2263)

DIFFERENTIAL DIAGNOSIS OF

Frequency of Urination

Frequency of urination accompanies polyuria (p 2231) and dysuria (p 2325) It is infrequently encountered as an isolated symptom when the patient reports an excessive number of void ings without pain or increased urinary output.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	Stenosis of meatus or urethra visible by local examination (p 2286) Disturbances of the urethral valves Hypertrophy of the verumon tanum or the vesical neck as revealed by posterior urethroscopy (p 2247)
Urethral	Phimosis urethritis and caruncle (p 2338) Make local inspection and get spread of ure thral discharge (p 50)
Cystic	Inflammation, neoplasm or calculi of bladder (p 2317) Diverticulosis and diverticulitis as revealed by cystogram (p 2286)
Pelvic	Following coitus Pressure of displaced, en larged or pregnant uterus Onset of labor Endometriosis with fixation of uterus and dy menorrhea (p 2558) Seminal ve iculitis and prostatitis confirmed by rectal findings (p 2467) Salpingitis oophoritis and ovarian cysts or neoplasms as revealed by recto vaginal examination (p 2608)

Whether treated conservatively or by operative interference the pa tient who has suffered a renal injury is ordered to report for examination at stated periods The scarring that inevitably follows often results in in sidious disturbances in renal function These may be detected early and prevented by means of control pyelography studies of renal function and observation of blood pressure

At times *aspiration of a perirenal hematoma* seems justified The pro cedure however may initiate fresh bleeding and invite infection Against the dangers of conservatism is the risk of producing *renal ischemia* with its consequences (p 2273) if the clot is permitted to remain within the capsule of the organ

Size.—*Urinary calculi vary in size from small pepper grains to large masses weighing several pounds. Minute masses of crystals lacking the definite structure of true calculi are regarded as *gravel* and are commonly present in association with calculi. *Renal calculi* filling the entire renal pelvis may weigh 400 to 500 gm. *Ureteral calculi* are usually small but at times assume impressive proportions. *Vesical calculi* are frequently large and may reach great size. Small stones, *particularly ureteral stones, are often attended by severe colic while* large stones are usually silent.

Gross Appearance.—The gross appearance of the stone varies with the site of formation and the chemical composition. *Urate and uric acid stones* are hard, elliptical and have

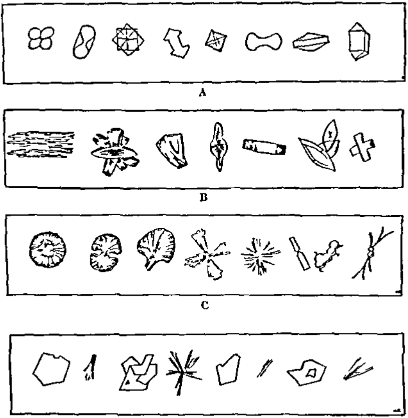


Fig 550.—Urinary crystals. *A*, Calcium oxalate. *B*, Uric acid. *C*, Urates. *D*, Leucin and tyrosin.*

a yellow color; the surface is smooth or irregular and simple or laminated varieties occur. *Oxalate stones* are hard, irregular and rough but occasionally they may be smooth and elliptical. They are clear brown, gray or black due to blood pigment. They may be shaped like small faceted peas, rough spherical, or shaped like jack stones with smooth cylindrical arms. *Phosphate calculi usually form about a uric acid or oxalate nucleus. They* are usually soft, a light dirty color and tend to form a cast of the renal pelvis forming the "staghorn calculus." Laminated stones are common. Pure *calcium phosphate stones* are hard and white with a smooth surface and a crystalline structure. *Cystine* stones are almost entirely crystalline with a minimal amount of organic framework. They are usually staghorn in the renal

* Pelouze, Office Urology

insolubility of these substances in urine Calcium may be deposited around the concretions of the drug and renal function seriously impaired resulting in anuria *Sulfonamide concretions* are avoided by administering sodium bicarbonate with the chemotherapeutic agent in the ratio of 2 gm of alkali to 1 gm of the drug

The large amounts of *absorbable alkali* (sodium bicarbonate) taken internally for many years by patients with dyspepsia and peptic ulcer predispose to urolithiasis

THE NATURE OF URINARY CALCULI

Urinary calculi may be *simple* with the same composition throughout and a uniform appearance on cross section or *laminated* consisting of concentric layers and having a definite radial appearance on cross section Every stone has a central nucleus composed of a foreign

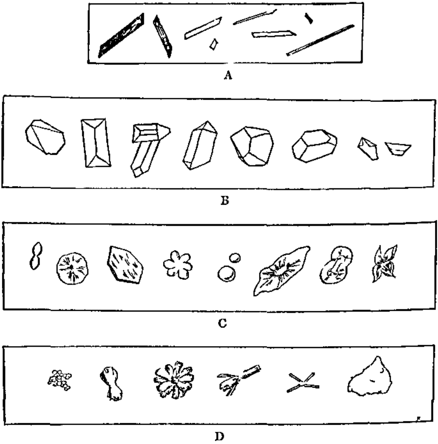


Fig 549—Urinary crystals *A* Hemin crystals *B* Ammoniomagnesium crystals *C* Calcium carbonate *D* Calcium phosphate *

body necrotic tissue bacteria or a urinary crystal and an organic stroma or cement substance which prevents disintegration

Chemical Compositio —The composition of calculi varies with their localization in the urinary tract and with the factors involved in their production The majority of stones are mixtures of salts of calcium ammonium sodium and magnesium with urates oxalates phosphates and carbonates Pure stones are rare and are composed almost entirely of uric acid cystine xanthine leucine calcium phosphate calcium oxalate or calcium carbonate

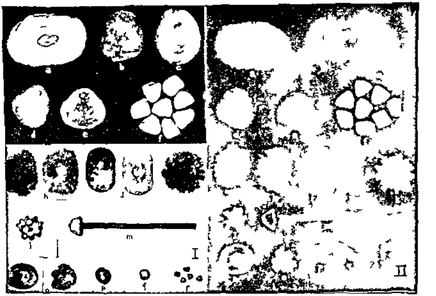
Renal calculi usually consist of oxalates or phosphates while *vesical calculi* are of uric acid and urate composition The influence of etiological factors is indicated by the occurrence of calcium phosphate stones in hyperparathyroidism of uric acid and urate stones in patients with uraturia and of cystine stones in cystinuria

* Pelouze Office Urology

the opposite flank as the result of the reno renal reflex The ache often resembles lumbago or sciatica There is persistent discomfort in the epi gastrium or the testis

Hematuria occurs in a large proportion of these patients Gross bleed ing may persist for a long time but more often the manifestation is inter mittent and precipitated by physical exertion The presence of compli cating infection which is inevitable results in a *dysuria* and attacks of *intermittent fever* often associated with a *sudden chill*

The most dreaded complication of bilateral upper urinary tract concre tions is *calculous anuria* The exact mechanism for the production of this disturbance is not quite clear since occasionally it occurs in unilateral



Fi 551 —Different stages of rad opac ty of vesical calculi I *a* Calc um phosphate *b* uric ac d *c* c oss sect on of *b* *d* oute laye of calcium phosphate and nucleus of calcium oxalate and phosphate *e* cross sect on of *d* *f* calcium o alate ca bonate and phosphate; *g* calcium oxalate *h* cross section of *g* *i* uric acid with small amount of calcium oxalate *j* cross section of *i* *k* and *l* calcium o alate *m* calcium phosphate deposits on a mushroom catheter *n* calcium phosphate *o* calcium oxalate *p* uric ac d *q* calcium oxalate *r* cal c um oxalate trace of uric acid II X ray shadows cast by each of the abo e *

lithiasis following an operative procedure or during an attack of renal colic when a reno renal or ureterorenal reflex is established Failure to relieve the anuria results in a rapid increase of the blood urea but there may be relatively few symptoms for a period of as long as one or two weeks when uremia finally develops

Renal colic (p 2274) which occurs when a stone enters the ureter is present at some time in the majority of instances The typical severe attack is characterized by the sudden onset of intense *agonizing pain* which starts in the flank of the involved side and radiates to the testis penis vagina or inner aspect of the thigh Less often it is misleadingly referred to the chest interscapular region or anterior abdomen

* Young and Waters From Hinman Principles and Practice of U ology

pelvis and spherical in the bladder The surface may be smooth or rough and granular The color varies from a light yellow green to a dark bluish green They are soft and light

PATHOLOGY

In addition to their physical presence calculi produce varying degrees of pathologic change in the components of the urinary system

Renal Calculi—Renal calculi are frequently accompanied by marked destruction of the kidney in which they form The presence of a stone quickly leads to local irritation obstruction and infection Pressure of the stone on the adjacent renal tissue causes *ulceration* which may destroy much of the kidney even without infection The stone, acting as an irritant stimulates the deposition of connective and fatty tissue in and around the kidney leading to *perirenal sclerosis* It may ulcerate through the pelvic wall into the perirenal tissues

Obstruction is associated with *back pressure* and dilatation of the proximal portion of the pelvis and calices Occasionally the whole pelvis becomes dilated from a stone which is impacted in the ureter or at the pyelo-ureteral junction creating a hydronephrosis with atrophy and sclerosis of the parenchyma Obstruction of the isthmus of a calix leads to hydrocalix.

Infection is present in almost all instances and it is often difficult to ascertain whether it antedated or followed the formation of the calculus *Pyelonephritis* (p 2303) due to the colon bacillus or staphylococcus is common and infections with *B proteus* favor the rapid growth of phosphate stones which may completely fill the pelvis

Ureteral Calculi—Ureteral calculi are almost always of renal origin Rarely a stone forms in a ureteral sacculation or dilatation associated with stricture As it passes downward the calculus is usually arrested at the pyeloureteral junction or at the lower portion which is narrowed by its oblique course through the vesical wall Arrest of the stone quickly causes obstruction to the flow of urine and dilatation of the upper urinary tract, and pressure of the stone causes a localized ureteritis which is followed by stricture formation Rarely a periureteral abscess may occur Occasionally a moderate sized ureteral calculus becomes canalized reestablishing the patency of the ureter

Vesical Calculi—Vesical calculi are usually multiple and of small size in the presence of urinary stasis and infection Large solitary stones are found in the absence of urinary retention The principal effect of the stone is mechanical irritation of the bladder wall Smooth stones are well tolerated while rough spiculed calculi produce marked trauma The stone may intermittently obstruct the urethral orifice leading to acute elevation of intravesical pressure which favors hypertrophy of the bladder wall trabeculation the formation of diverticula and ascending infection leading to *bilateral diffuse pyelonephritis* Dilatation of the ureters may occur as a result of direct mechanical obstruction by large stones or from stricture formation

Prostatic Calculi—See p 2436
Urethral Calculi—See p 2319
Preputial Calculi—See p 2427

CLINICAL MANIFESTATIONS

The clinical manifestations and therapeutic indications in *urolithiasis* are greatly dependent upon the site of the calculus formation Upper tract stones are technically inaccessible and lower tract concretions carry the threat of bilateral backflow and infection

Renal and Ureteral Calculi—Renal and ureteral calculi are most common in adult life but occur at any age *Uric acid* calculi may be present in newborn infants and cause *priapism* (p 2411) in the neonatal period Males are somewhat more frequently affected than women except in the urolithiasis of hyperparathyroidism (p 1225) which usually is seen in multiparas

Calculi that remain within the renal pelvis and calices are *asymptomatic* for long periods of time Sooner or later however they often give rise to suggestive manifestations Often a *dull soreness* is felt in the lumbar region of the affected side The discomfort may radiate to the groin or to

by intravenous urography or the introduction of radiopaque ureteral catheters (p 2251)

Cystoscopy—Cystoscopic study reveals data of considerable prognostic value in urolithiasis of the upper tract The ureteral orifice may be swollen edematous hemorrhagic or lacerated indicating the presence of an intramural ureteral calculus or its recent passage The orifice may be anatomically normal but bloody or cloudy urine is seen coming from the involved side

The passage of a *ureteral catheter* may be impossible beyond the site of the stone and there may be a calculous anuria More often the capacity of the pelvis is increased and abnormally large volumes of urine are aspirated The excretion of phenolphthalein or indigo carmine may be absent



Fig 2—Roentgenogram in a case of bilateral renal calculi The extensive stone formation was associated with advanced renal destruction Inoperable

on the involved side and other renal function tests performed with the catheter in place often reveal a considerable degree of renal failure

The passage of a *wax tipped ureteral bougie* or a *wax bulb catheter* may show characteristic scratch marks and filling defects may be noted in the intravenous and retrograde pyelograms

Vesical Calculi—Vesical calculi are usually seen *in middle aged males* with prostatic obstruction (p 2445) *In women* vesical calculi form around a foreign body or occur in association with an antecedent chronic cystitis Perhaps 20 per cent of vesical calculi are associated with stones in the kidney or ureter and it may be assumed that the bladder is the site of the subsequent growth of a small stone passed from the upper urinary tract In Central Europe Asia Minor and Asia vesical calculi are the commonest types of urinary stone and are frequently seen in children

The attack of renal colic usually lasts a few minutes and rarely longer than a few hours Severe paroxysms are attended by nausea vomiting and peripheral circulatory collapse manifested by pallor cold perspiration rapid feeble pulse and low blood pressure The pain may be preceded by a sore feeling in the flank and a chill followed by a rise in temperature to 103 to 104° F Osler described three varieties of pain which occur in attacks of renal colic A constant localized dull pain the area of which can be covered on the skin of the back in the renal region by a penny piece and which can be imitated exactly by deep firm pressure paroxysms of pain radiating in the course of the ureter or into the flank which as they increase are accompanied by sweating fainting and nausea flushes or rushes of hot pain at intervals often momentary, usually passing to the back less often to the groin' In colic due to a stone impacted in the lower ureter the pain is usually localized to the lower abdomen and bladder regions Changes in the location of the pain tend to parallel the descent of a ureteral calculus

Examination of a patient with renal colic frequently reveals nothing more than *costovertebral tenderness* although there may be associated rigidity of the abdominal muscles on the affected side With stone in the lower third of the ureter there is apt to be tenderness and muscle spasm in the lower quadrants Occurring on the right side the renal colic simulates *acute appendicitis* (p 1881) The testis and scrotum are usually retracted on the affected side and the thigh is often flexed The clinical picture is completed by frequency of urination urgency burning and hematuria A moderate leukocytosis is often present

Renal Function—In *unilateral lithiasis* renal function may be unimpaired being maintained at a normal level by the uninvolved kidney However the function of the stone bearing kidney is eventually reduced as indicated by a decreased excretion of indigo carmine and impaired urea clearance

Unilateral calculous pyelonephritis must be regarded as a threat to the normal kidney It may give rise to *hypertensive cardiovascular disease* (p 953) which is attended sooner or later by vascular lesions in the kidney that is free from stone An acute reflex renal ischemia may be a cause of calculous anuria in patients with unilateral lithiasis

In *bilateral lithiasis* the degree of renal failure depends on the amount of renal parenchyma that is damaged by the combination of obstruction pressure and infection *Chronic renal insufficiency* (p 2275) is frequent and may be accompanied by *renal hyperparathyroidism* (p 1228) It is often impossible to differentiate renal hyperparathyroidism with bilateral lithiasis from primary hyperparathyroidism with secondary calculus formation *Uremia* (p 2278) is the terminal phenomenon when irreparable renal damage has been produced by the presence of calculi

Urography—Most renal calculi are *radiopaque* and may be demonstrated in the scout film (p 2250) About 5 per cent of calculi are *radiotranslucent* due to their small size position or chemical composition of uric acid or cystine

Extra ureteral shadows often simulate renal concretions Calcified mesenteric lymph glands phleboliths gallstones cutaneous papillomas and intra intestinal foreign bodies cause confusion which is definitively clarified

by intravenous urography or the introduction of radiopaque ureteral catheters (p 2251)

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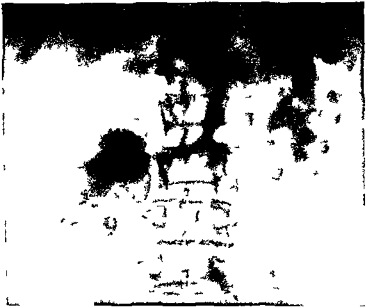


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The clinical manifestations produced by a vesical stone are chiefly the result of bladder irritation obstruction of the urethral orifice and superimposed infection of the urinary tract To a certain extent the clinical picture varies with the size mobility and type of stone Large smooth and encysted stones are usually quiescent The symptoms of prostatic obstruction and vesical infection may predominate, the stone being discovered incidentally by radiography or cystoscopy

Freely movable small irregular stones result in the most marked discomfort when they are swept into the sensitive vesical outlet during micturition They provoke severe *strangury* with intense pain and profuse *bleeding at the end of urination* The calculus may produce a sudden painful *stoppage of the stream of urine* by blocking the urethral orifice Occa-



Fig 553—Ureteropyelogram showing normal pelvis to inner side of which are 2 shadows of large gallstones Note that pyelographic medium has extended beyond calices at certain points (pyelovenous backflow) *



Fig 554—Roentgenogram showing a large vesical calculus which occurred in association with generalized prostatic hypertrophy in an aged full blooded Negro Two-stage prostatectomy successful Pennsylvania Hospital case *

sionally the assumption of the recumbent position dislodges the stone with relief from pain and the ability to complete the emptying of the bladder Dysuria is usually aggravated by exertion and relieved by rest Vesical pain is often referred to the rectum perineum testes inguinal regions and thighs

Physical examination usually reveals no findings indicative of the presence of a calculus Large stones are sometimes palpable through the rectum and in women on bimanual examination Hematuria (p 2306) is almost always present and urinary hemorrhage may be extremely profuse Invariably the urine contains pus and there may be systemic manifestations due to an acute cystitis or bilateral diffuse pyelonephritis

* Herman The Practice of Urology

Radiography—In attempting to visualize bladder stones by means of the radiograph the film should reveal the outline of the bladder and the details of the bony structures The shadows cast by vesical stones are contained within the bladder shadow and have to be differentiated from phleboliths stones in the intramural portions of the ureters prostatic calculi and rectal foreign bodies Many bladder calculi are radiotranslucent especially those composed chiefly of urates

Cystoscopy—Cystoscopy allows direct inspection of the calculus which often indicates its chemical composition and yields valuable data regarding the condition of the vesical wall A stone may be missed when it is encysted hidden in a sacculation and if good visualization is impossible because of extreme irritability of the bladder or the presence of persistent bleeding

Urethral Calculi—As a rule ureteral calculi traverse the urethra without producing significant difficulty or discomfort Occasionally however a rough stone causes intense irritation followed by impaction of the calculus within the urethra The most common sites for trouble are the prostatic and membranous portions of the urethra in the male Rarely a stone forms primarily within the urethra behind a tight stricture or in a diverticulum

The principal symptoms are acute dysuria bleeding from the penis and acute retention of urine A stone entering from the bladder may reenter the viscus spontaneously or be pushed back during catheterization

Preputial Calculi—See p 2427

Prostatic Calculi—See p 2436

TREATMENT

The treatment of urolithiasis is predominantly prophylactic so far as the practitioner is concerned Once stones have formed the problem usually passes out of his province to the field of the technical expert

Prevention of Urolithiasis—Stone formation is effectively prevented by prompt measures aimed at eliminating urinary stasis and sepsis by the simple expedients of forcing fluids in the presence of known precipitating factors and of altering the urinary reaction when indicated In rare instances parathyroidectomy (p 1231) is required

Flushing the kidneys by increasing water intake is desirable in the presence of *urinary infection* with excessive excretions of *calcium* (in osseous disease and hyperparathyroidism) with *hyperuricuria* (in gout leukemia and other blood dyscrasias) when *excess alkali* is ingested for digestive disorders and during *chemotherapy* with the sulfonamide drugs

Adjustment of urinary reaction whether excessively acid or alkaline is required unless the metabolic derangement has been deliberately produced for therapeutic purposes Patients who pass a highly acid urine are given adequate doses of *bicarbonate of soda* while those whose specimens are unduly alkaline are corrected with *ammonium chloride* (p 614)

Enthusiasts for vitamin therapy advocate the use of large doses of *vitamin A* While this can certainly do no harm it would seem to promise few benefits except in the presence of an obviously deficient diet

Active Treatment—The active treatment of renal lithiasis is influenced by a large number of variables which include the location of the stone

their numbers size and position and the anatomical and functional status of each kidney

Dietotherapy—Dissolution of renal calculi has been attempted by dietary regulation the administration of drugs and by intra ureteral lavage An *acid ash diet* (p 680) high in *vitamin A* is claimed to reduce the size of acid soluble urinary calculi and prevent their recurrence after removal The effect of the metabolic factor is enhanced by the administration of *ammonium chloride* (p 614) in dosages of 3 to 6 gm daily in order to keep the *p*H of the urine below 5 Advocates of this form of therapy report encouraging results but our experiences have not been so fortunate Certainly the method is worthy of trial provided that the salt is discontinued every few days to prevent excessive disturbances of the electrolyte pattern

An *alkaline ash diet* (p 681) has been advocated for the solution of cystine and uric acid stones This regimen is fortified by the administration of alkalies such as *bicarbonate of soda* with the same results and precautions above mentioned Patients who have oxalate stones are advised to avoid fruits vegetables chocolate and coffee which are rich in this substance

Fluids—Whichever type of chemical control is attempted the patient is urged to drink *large quantities of fluid* in order to provide an adequate flushing of the kidneys It is however disappointing to report that disintegration of a stone despite conscientious adherence to these measures is an unusual sequel and the prevention of re formation is hardly more successful

Chemical Dissolution—A more direct attack on the problem of dissolving renal calculi requires flushing of the urinary pelvis with chemical solutions This method involves necessarily catheterization of the ureters The procedure is still in an experimental stage but is enthusiastically described by its advocates The solution that is being employed for the dissolution of phosphatic urinary calculi consists of monohydrated citric acid 32 25 gm anhydrous magnesium oxide 3 84 gm anhydrous sodium carbonate 4 37 gm and water to 1000 cc

Parathyroidectomy—Those patients who evidence manifestations of hyperparathyroidism require surgical treatment aimed at the disturbance in the endocrine glands (p 1225)

Drug Therapy—The patient with renal colic requires relief from pain The injection of *morphine* is avoided for as long as possible and efforts are made to ameliorate the condition by hot baths colon irrigations and the administration of *antispasmodics* such as *nitroglycerin atropine* and its synthetic substitutes (p 3875) or by the intravenous injection of *calcium gluconate* (p 604) *Demerol* in doses of 50 to 200 mg may furnish the ideal preparation for the management of renal colic since relaxation of smooth muscle and analgesia are obtained simultaneously (p 3863)

If the patient cannot be relieved it may be necessary finally to inject *morphine sulfate* with *atropine sulfate* For subcutaneous injection ¼ grain of the former and 1/100 grain of the latter suffice for the initial dose A more efficient and more rapid action is made possible by slow intravenous introduction Those who react poorly to morphine are given *dilaudid* 1/32 grain

Superimposed urinary infection is best treated with a course of intramuscular injections of streptomycin (p 104) using 250 000 to 500 000 units four times daily *The sulfonamides also are suited to this indication* Each gram of the chemotherapeutic agent is given with 2 gm of *sodium bicarbonate* in order to prevent the deposition of crystals of the urinary excretion products Patients who do not tolerate sulfonamides or fail to respond are given *mandelic acid* (p 2256) as *calcium mandelate* 3 gm four times daily or a course of penicillin (p 106)

Treatment by the Urologist —The expert urologist accomplishes considerable benefit by endoscopic procedures The renal pelvis may be lavaged after ureteral catheterization Small stones are often removed and encouraged to make their way into the bladder by persistent manipulation with indwelling ureteral catheters and the instillation of sterile albolene Often if nothing else is accomplished back pressure is relieved by drawing off retained urine A stricture may be dilated by the instrumentation

Contraindications to Manipulation —Ureteral manipulation is not without danger The ureter may be perforated or an ascending infection may be initiated A *urinary sepsis* occasionally follows immediately as the result of a *pyelovenous reflux* (p 2270) In view of these hazards many urologists assert that manipulation is contraindicated if the stone in the upper ureter is of a size greater than 1 cm if the stone in the lower ureter is of a size greater than 3 cm if the stone is fixed if there is a complicating and serious renal back pressure or infection if initial attempts at manipulation have failed if initial attempts at manipulation have produced severe reactions

Value of Manipulation —Against these ominous precepts are recorded the accomplishment of the passage of more than 70 per cent of ureteral calculi after instrumental manipulation Hinman by way of encouraging non operative treatment asserts almost every urologist has succeeded in the instrumental delivery of stones for which operation had been advised by another who believed their spontaneous passage to be impossible or fraught with grave danger and every urologist has experienced the same surprise and embarrassment himself

Operative Therapy —Surgery is required in approximately 5 per cent of *ureteral calculi* Often it is necessary merely to do a ureterolithotomy However when the simpler procedures fail ureteronephrectomy or nephrectomy becomes necessary provided that the other kidney is proved to be present and functionally adequate

The problem of the removal of *vesical calculi* is much simpler Often the stone can be grasped and removed At other times it is possible to crush the calculus and wash out the fragments Only on rare occasions is it necessary to perform a suprapubic cystostomy for the operative removal of the concretion

In his technical approach to the problem of urolithiasis the surgeon bears in mind constantly the effects of unilateral renal involvement upon the healthier kidney and the functional efficiency of the renal parenchyma Removal of a grossly infected kidney may salvage the less involved organ on the opposite side On rare occasions if the renal condition has been alleviated the terminal hypertensive cardiovascular disorder abates

CHAPTER 110

THE URINARY SYSTEM NEOPLASMS VASCULAR AND NEUROGENIC DISTURBANCES

Tumors of the Bladder
Tumors of the Ureter
Tumors of the Renal Pelvis
Tumors of the Kidney
Occlusion of a Main Renal Artery
Thrombosis of Main Renal Veins
Aneurysm of the Renal Artery
Perirenal Hematoma
Renal Infarcts
The Neurogenic Bladder

Benign and malignant tumors of the bladder and kidneys offer a fertile field for the investigation of malignancy and have already yielded significant clues of both practical and theoretical importance They are frequently encountered in clinical practice and the malignant growths have a considerable menace

Certain of the bladder tumors are especially revealing with respect to the problem of carcinogenesis It is known for instance that chronic irritation is associated with malignant change in vesical schistosomiasis chronic cystitis with leukoplakia and papillomas More significant is the incidence of bladder tumors in those who work with aniline dyes In these cases a carcinogenic substance excreted in the urine seems to be the causative agency in the pathogenesis of the malignancy and this observation furnishes at least one tangible clue upon which cancer research may be initiated

TUMORS OF THE BLADDER

The majority of bladder tumors arise from the vesical epithelium *Benign* and *malignant papillomas* and *sessile infiltrating epithelial growths* are encountered with great frequency The rarer types include *fibromas sarcomas myxomas myomas leiofibromas angiomas rhabdomyomas adenomas cystadenomas dermoids teratomas* and *chondromas* Since definitive diagnosis of the type of neoplasm rests with the histological diagnosis the generic clinical problem of bladder growths is considered in the material that follows

Pathology —The *benign papilloma* of the bladder is the most common vesical tumor and is generally regarded as being potentially if not actually malignant The growth is composed of papillae which reproduce the color and texture of the vesical mucosa When fully developed they possess short clublike processes or branching fimbriae The latter are very delicate and easily agitated by the urine currents Several papillomas may be present in a localized area of the bladder or a number may have a common pedicle A frequent site of the growth is the region of the ureteral orifices The bladder papillomas possess the capacity of reproducing themselves by implantation in the neighboring vesical wall *Multiplicity* is regarded as precursor of malignancy *Malignant degeneration* is marked by fusion of the delicate fimbriae which gives the tumor a more solid appearance Fortunately for the efficacy of treatment by fulguration the benign papilloma does not produce infiltration at the base of the tumor or in the region of the adjacent vesical wall

The *papillary carcinoma* is malignant from the onset and invades the bladder wall at an early date The tumor grows rapidly it has a solid appearance and a thick pedicle There is usually some infiltration of the adjacent bladder wall and partial necrosis of the tumor

Approximately 10 per cent of epithelial tumors of the bladder are *sessile nonpapillary cancers* They appear as solid invading neoplasms with a nodular ulcerated surface Histologically they may be differentiated as *epitheliomas squamous cell carcinomas* and *adeno carcinomas* Favorite sites for these growths are the regions of the *trigone* and the *vesical neck* Metastases occur fairly late The regional lymph nodes are first invaded and then the bones liver and lungs

Clinical Manifestations—The symptoms and signs of bladder tumors are dependent upon the type and location of the growth the extent of perivesical invasion the presence of secondary infection the degree of ureteral occlusion and the circumstance of metastatic deposits

The early finding is usually *hematuria* which is an initial symptom in 75 per cent of papillary growths The bleeding is painless intermittent and usually moderate in amount Rarely there may be a brisk hemorrhage with the formation of intravesical clots whose passage causes intense pain and strangury

Dysuria is not often present but is a disturbing symptom and usually signifies invasion of the bladder wall *Frequency of urination* is a common complaint which may be a herald manifestation Sudden painless stoppage of the urinary stream occurs when small pedunculated tumors block the vesical outlet

With secondary infection or ureteral occlusion there are symptom and signs of *cystitis* (p 2342) or *hydronephrosis* (p 2284) Perivesical extension produces *pain* in the perineum rectum or vagina There may be *incontinence* due to the presence of vesicovaginal fistula or an intestinal obstruction

Physical examination is usually misleadingly normal unless large tumors can be palpated suprapubically or induration of the bladder wall is detectable on rectal or vaginal examination

Diagnosis—The definitive diagnosis of a bladder tumor requires *cystoscopy (p 2248) and radiography (p 2250)* The former enables the examiner to determine the number locations and characteristics of the tumors and the presence of associated lesions A specimen may be obtained for *biopsy* in order to guide the specialist in his decision concerning definite diagnosis and therapy

Cystography permits of visualization of tumors near the vesical neck in diverticula and in other sites that cannot be explored by direct vision The neoplasm appears as an irregular filling defect an appearance that may be simulated by a blood clot

For Differential Diagnosis see *Hematuria* (p 2306) *Dysuria* (p 2325)

Treatment—The treatment of the bladder tumor depends on the type of growth determined by histological examination the grade of malignancy and its location in relation to the trigone the vesical neck the ureteral orifices and the roof of the bladder

The majority of *papillomas* may be removed by electrocoagulation *using cystoscopic fulguration Recurrences occur in 10 to 20* per cent of instances but subsequent growths respond well to similar procedures

The larger inaccessible and *infiltrated tumors of the bladder* require operation The tumor is destroyed by diathermy (p 3788) followed by a wide resection of the bladder and reimplantation of the ureters (p 2263) The results are not very satisfactory with an immediate mortality approxi

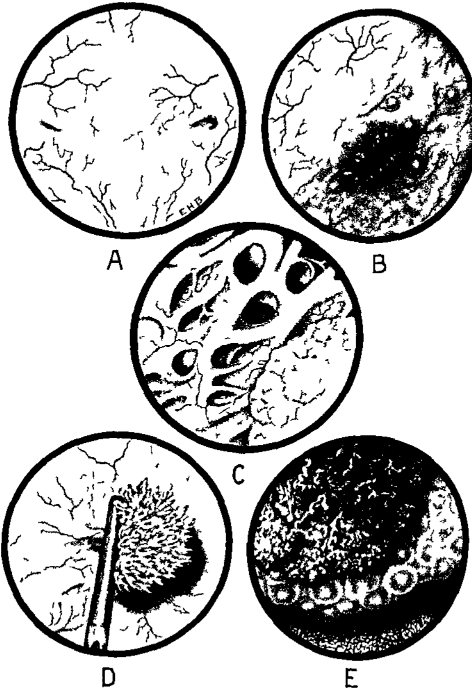


Fig 555 —Cystoscopic views *A* Normal trigone and neighboring bladder mucosa with two types of normal ureteral orifices *B* Tuberculosis of bladder showing tubercles and rigid dilated left ureteral orifice *C* Coarse trabeculation of bladder wall with vesical calculus *D* Papilloma with benign characteristics delicate villi small pedicle absence of bladder wall infiltration *E* Malignant neoplasm with broad base presenting solid appearance infiltration sugested by edema and congestion of bladder wall *

Alexander R Stevens and Frederick C McLellan in Pullen Medical Diagnosis

mating 10 per cent and long range cures that do not exceed 40 per cent The tumors are friable and implantations occur along the operative field with great frequency Total cystectomy is a formidable procedure and requires previous diversion of the urinary stream by an uretero intestinal implantation

DIFFERENTIAL DIAGNOSIS OF

Dysuria, Urgency and Strangury

Dysuria urgency and strangury represent examples of painful urination With dysuria there is discomfort during micturition Urgency is the term applied to an irresistible necessity for emptying of the bladder Strangury the most uncomfortable of all the urinary symptoms is encountered when there is intense perineal discomfort and the voiding of but a few drops of urine with intense pain

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	In hysteria
Spasmodic	*Perineal spasms particularly following prostatectomy*
Penile	Following injury Phimosis paraphimosis balanoposthitis urethral stricture or caruncle and acute urethritis *Make smears and cultures* of urethral discharge (p 50) Consider urethroscopy (p 2247)
Pelvic	Vaginitis urethral caruncle oophoritis and salpingitis (p 2608) Get vaginal and urethral spreads (p 50) and check sedimentation time (p 3707) Endometriosis with fixation of uterus and dysmenorrhea (p 2558) Seminal vesiculitis and prostatic disease *be t revealed* by rectal examination (p 2467)
Cystic	*Diminution in size of bladder* Diverticula as revealed by cystograms (p 2286) Increased *bladder* tonus *measured by cystometry* (p 2248) Rupture of bladder and other types of trauma Foreign bodies introduced per urethram Inflammations neoplasms calculi *and schistosomiasis revealed by cystoscopy* Examine urine for tubercle bacilli (p 50) Get cultures and guinea pig inoculations (p 63)
Renal	*Acute pyelonephritis (pyelitis) Renal tuber*culosis (p 2347) or lithiasis (p 2314) *Refer to* specialist for urography cystoscopy catheterization of ureters and examinations of differential specimens Search for tubercle bacilli and inject into guinea pig (p 63)
Urinary	Passage of highly acid urine oxalates calculi or gravel

Small sessile papillary carcinomas with no gross evidence of widespread infiltration often respond to a combination of fulguration followed by *endovesical irradiation* using radon seeds (p 3796) The latter procedure is hazardous and may result in an extensive radium burn

TUMORS OF THE URETER

Primary tumors of the ureter are rarely observed They are pathologically similar to those of the bladder Occasionally the ureter is the site of metastasis from a cancer of the cervix stomach kidney bladder or prostate gland but the diagnosis is ordinarily only of academic importance

Pathology—*Benign papillomas* are the most common ureteral growths They may be single or multiple and may produce secondary implantations in the bladder They are to be regarded as *potentially malignant* since many show areas of malignancy or a tendency toward invasion The *papillary carcinoma* is malignant from its inception *Nonpapillary carcinomas* are of the solid medullary varieties or they appear as squamous cell neoplasms

The papillary and nonpapillary carcinomas of the ureter may reach tremendous size and produce deposits in other areas of the ureter and bladder Occasionally they present themselves at the ureteral orifice or they may be palpable on rectal or vaginal examination *Metastases* are early and widespread to the lymph glands peritoneum liver lungs and bones Obstructing lesions produce dilatation of the upper urinary tract with hydronephrosis

Clinical Manifestations—*Hematuria* is the usual presenting symptom of a ureteral neoplasm Occasionally there may be *pain* which radiates from the lower abdomen to the lumbosacral region and thigh If there is an associated *hydronephrosis* the symptoms derive from the mechanical obstruction and include pain in the lumbar region and the presence of a renal tumor

More definitive information is obtained by *cystoscopy* (p 2248) and urography The former examination may reveal the tumor protruding from the orifice or suspicion may be aroused by a flux of blood from the orifice or bleeding when the ureteral catheter is manipulated at the level of the tumor A clear or chocolate colored fluid may be obtained on aspiration when the catheter is pushed beyond the level of the tumor By *urography* (p 2250) the suspicious findings are the presence of a hydronephrosis that is otherwise inexplicable and the demonstration of a filling defect in the ureter in the absence of positive evidence of a calculus

Treatment—The treatment of a neoplasm of the ureter requires specialist assistance These tumors are often malignant and tend to recur The only safe procedure is a complete ureteronephrectomy in which a cuff of bladder wall is removed at the point where the ureter opens into that viscus

TUMORS OF THE RENAL PELVIS

Tumors of the renal pelvis are uncommon and are similar anatomically to vesical neoplasms *Benign and malignant papillomas* and *nonpapillary sessile carcinomas* are encountered Rarely a connective tissue tumor such as a *sarcoma* or a *rhabdomyosarcoma* is met with but so seldom that it is a curiosity

The *clinical manifestations* and *treatment* of tumors of the renal pelvis are similar to those of the renal parenchyma which are described in the following pages

TUMORS OF THE KIDNEY

Tumors of the renal parenchyma are difficult of classification but there is agreement that nearly all are *malignant* and are variants of the *carcinoma* or *hypernephroma of Grawitz* and the *embryoma of Wilms* They

are all of a high grade of malignancy and difficult of early diagnosis. Treatment is discouraging since five year "cures" after nephrectomy are rare and the tumors respond poorly to roentgen therapy.

Pathology.—The *carcinoma* is the commonest form of malignant renal tumor and comprises from [illegible] to 85 per cent of these growths. It is commonly known as *hypernephroma* according to the suggestion of Grawitz (1883) who thought it was derived from adrenal rests included in the cortex. Modern evidence is in favor of a renal origin of the tumor which occasionally shows a tubular formation never seen in adrenal or adrenal cortical tumors. Moreover the endocrine features of adrenal tumors are absent.

Grossly the tumor appears as a rounded mass in the upper or lower renal pole. It may vary from the size of a walnut to an enormous growth that almost fills the abdominal cavity. On cross section the tumor has a bright yellow color and contains cysts and hemorrhagic areas. Some cysts are filled with serous fluid while others represent areas of necrosis and hemorrhage. There is a fairly well developed fibrous capsule especially about small rounded tumors. *However the growth breaks through early and invades the renal pelvis, the adjacent* renal parenchyma and the renal veins and extends into the inferior vena cava.

The histological appearance is usually very characteristic. The tumor cells are large, rounded and have a clear or vacuolated cytoplasm due to the presence of large amounts of cholesterol ester and glycogen. The tumor is very vascular and has a scanty stroma. Metastases occur early by way of the blood stream. The lungs and bones are commonly involved, the liver, brain and regional lymph nodes somewhat less often. In the lungs the metastases may give rise to large discrete round and solid masses of tumor tissue ("cannon ball" appearance) or a fine irregular lattice work due to lymphangitic spread in the pulmonary interstices.

The *embryoma* is a highly malignant tumor that usually occurs in childhood and comprises about 20 per cent of invasive new growths in early life. This neoplasm, also known as *Wilms tumor*, is generally regarded as an embryonal mixed growth. Both kidneys may be involved. The tumor arises in the cortex and may *attain huge proportions* in a short time. The normal renal tissue usually is reduced to a thin compressed false capsule and the kidney appears grossly as a large oval smooth or irregularly lobulated mass. The tumor is solid and heavy and may weigh almost as much as the patient. On cross section the tissue has the *soft gray homogeneous character of a sarcoma*. Numerous small cysts filled with serous or sanguineous fluid may be present.

Microscopically the appearance is that of a sarcoma. The cells are small, round or fusiform. Glandular elements resembling uriniferous tubules may be present and muscle, bone and cartilage are occasional constituents. Metastases are blood borne and commonly involve the liver and lungs. The tumor tends to break through its capsule and involve the surrounding structures.

Clinical Manifestations.—There is a sharp division in the age incidence of malignant renal tumors. Carcinomas of the renal parenchyma and pelvis are common in middle age, the average age incidence being 55. *Embryonal tumors appear within the first five years* and may develop in the kidney of the fetus. In any event the principal clinical manifestations are hematuria, pain and tumor.

The *hematuria* of renal malignancy is usually painless but due to the passage of clots may be associated with attacks of renal colic. In the adult carcinomas *gross hematuria* is present in 75 per cent of patients and microscopic bleeding is invariably present. Bloody urine however is less frequent in children with embryonal tumors. *Pain* in the flank is the presenting symptom of about one third of patients and is due to perirenal extension. It is apt to be severe in children with embryonal tumors.

The most important physical sign of a renal malignancy is the presence of a *hard irregular renal mass* which moves with respiration. The embryonal tumors of children produce marked prominence of the abdo

men and lower chest and are associated with a pronounced venous pattern on the chest and abdominal walls

The first evidence of a renal tumor may be produced by a distant *metastasis* A rapidly growing *varicocele* (p 2433) on the left side is suggestive of venous invasion Increasing cachexia anemia anorexia and loss of weight are terminal complaints Low grade *fever* is frequently present and may be the only abnormal finding *Arterial hypertension* is common in patients with carcinoma

Valuable diagnostic information is obtained from intravenous and retrograde *pyelograms* With small cortical tumors retrograde distention of the pelvis may mask a deformity that is readily apparent with the intravenous method The characteristic pyelographic findings are filling or

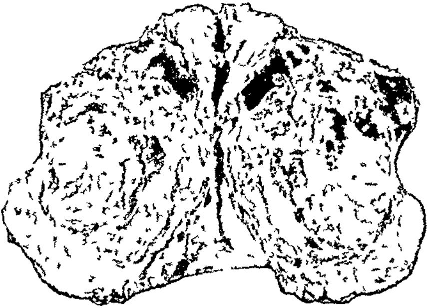


Fig 596—Embryonal nephroma of kidney (Photo by courtesy of Dr Lauren Ackerman)

compression defects and displacement or distortion of the kidney outline and ureter

Cystoscopy is valuable in localizing the site of bleeding and as a preliminary to ureteral catheterization The passage of bloody urine from the ureter in association with a papilloma of the bladder is suggestive of a primary papillary tumor of the renal pelvis

For Differential Diagnosis see *Hematuria* (p 2306) *Enlargements of Kidney* (p 2230)

Treatment —The patient with a carcinoma or embryoma of the kidney must be subjected to an immediate *nephrectomy* Tumor thrombi are sought in the renal vein and removed if possible *Preoperative roentgen therapy* is of little value in adults but produces a marked decrease in the size of embryonal tumors If roentgen therapy is given in a series of small daily doses and continued over a long period of time the regression may

* Moore Textbook of Pathology

be permanent as the result of gradual obliteration of the lumen of the more resistant blood vessels With pelvic growths a *nephro-ureterectomy* is indicated If the bladder is involved near the ureteral orifice the diseased areas also must be excised *Postoperative irradiation* is a valuable procedure in any renal malignancy but the overall prognosis in both types is poor

VASCULAR DISTURBANCES OF THE URINARY SYSTEM

The renal difficulties resulting from vascular disease of the finer capillaries are more properly discussed with the nephropathies and are found under the subheadings of *Diffuse Acute Glomerulitis* (p 2367) *Diffuse Nephrosclerosis* (p 2368) and *Acute and Chronic Glomerulonephritis* (p 2373) Additional material is included in the discussions of *Hypertensive Toxemia of Pregnancy* (p 2633) and *Essential Hypertension* (p 900)

The present material deals with the grosser abnormalities of the larger renal vessels such as occlusion of a main renal artery thrombosis of the renal veins aneurysm of the renal artery kidney infarction and perirenal hematoma *Anomalies of the renal vessels* are discussed in the section on *Congenital Malformations* (p 2296) and the larger problem of *renal ischemia* is included in the introductory remarks (p 2273)

OCCLUSION OF A MAIN RENAL ARTERY

The main renal vessel may be occluded by thrombi or emboli producing massive infarction of the kidney Depending on the size of the vessel involved the resulting *infarct* involves the entire kidney or only a localized wedge shaped area Thrombosis of the renal artery is usually the result of a generalized vascular disease such as *arteriosclerosis* (p 976) or *periarteritis nodosa* (p 1027)

Embolization of a large renal artery occurs in patients with a *mitral stenosis* associated with *auricular thrombi* Less often it is a complication of *subacute bacterial endocarditis* (p 1021) The principal clinical manifestation is a sharp *pain* in the flanks associated with *hematuria* or an acute *hemoglobinuria*

Occasionally the narrowing of the main renal artery by an arteriosclerotic process duplicates the Goldblatt experiment (p 2273) and leads to *renal ischemia* with resultant *hypertension* and *diffuse vascular disease* Unfortunately none of these conditions is amenable to therapy

THROMBOSIS OF MAIN RENAL VEINS

Thrombosis of the main renal vein is usually secondary to a primary inflammatory process involving the *renal parenchyma* Occasionally it occurs in the course of an extrarenal disturbance such as *lobar pneumonia* and it may also be involved with a *migrating thrombophlebitis* of the inferior vena cava and its tributaries Less often the renal vein is involved in the course of a *malignancy of the kidneys* (p 2326)

Thrombosis of the renal vein produces *hematuria* and if the occlusion is complete and persistent eventual destruction of the kidney Bilateral renal vein thrombosis gives rise to *massive albuminuria* with the production of *hypoproteinemia* and the *nephrotic syndrome* (p 2363)

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THE NEUROGENIC BLADDER

Vesical disturbances caused by lesions of the nervous system constitute a major threat to the functional integrity of the kidneys and urinary tract

Tabes dorsalis and other forms of *syphilis of the central nervous system* (p 1468) are responsible for 80 per cent of neurogenic bladders *Trauma* is a common cause particularly when the spinal cord is extensively damaged as in a *transverse myelitis* (p 1457) In military practice the injury may be inflicted by a penetrating object bone fragments or *hemorrhage* Some of the disturbances are encountered as *complications* of surgery involving the spinal column and cord Occasional examples are seen in association with brain tumor spinal cord tumor syringomyelia subacute combined degeneration of the cord (with or without pernicious anemia) arteriosclerosis and spina bifida occulta

Types of Neurogenic Bladder—The clinical types of neurogenic vesical dysfunction include the paralytic bladder the cord bladder the atonic bladder and the autonomic bladder

The *paralytic bladder* is seen immediately after an acute injury to the spinal cord The bladder loses its reservoir capacity and is completely toneless and functionless the sphincters are relaxed and open and urine enters the urethra continually As the acute injury subsides one of the other types of neurogenic bladder supervenes

Cord bladder follows involvement of the brain and cord There is paralysis of the detrusor mechanism (vesical musculature) associated with increased tonus of the external sphincter The result is *urinary retention* with *distention of the bladder overflow of urine* and *passive incontinence* In a typical example cystoscopy reveals a marked relaxation of the internal sphincter and a generalized ridgelike trabeculation The bladder and *urethral mucosa* usually are so insensitive that *cystoscopy* causes no discomfort

The *atonic bladder* results from a lesion affecting the terminal nerve supply to the bladder and may be difficult to differentiate from a cord bladder Usually the bladder wall is flabby and relaxed The internal sphincter is not dilated and there may be spasm of the external sphincter There is little or no trabeculation and the vesical mucosa may or may not be insensitive *Urinary retention* and *overflow incontinence* are common

With the *autonomic bladder* a permanent state of *periodic reflex micturition* results from extensive cord injury (transverse myelitis) The bladder functions as a reflex organ under the control of the spinal centers

Complications—Neurogenic vesical disorders that lead to *urinary obstruction* become complicated by urinary infection calculus formation renal insufficiency or vesical rupture

Diagnosis and Treatment—The patient with the neurogenic bladder is referred to the urologist for *cystoscopy* (p 2248) *cystometry* (p 2248) and *urography* (p 2250) In addition *neurological examination* (p 3583) and examinations of the *spinal fluid* (p 3734) are required to elucidate the problem and determine the indications and technics of surgery

For Differential Diagnosis see *Retention of Urine* (p 2264) *Incontinence of Urine* (p 2265)

ANEURYSM OF THE RENAL ARTERY

Aneurysm of the renal artery is a rare condition recognized only at operation or autopsy It may be asymptomatic but is capable of producing *occlusion* and *renal ischemia* or *thrombosis* with *infarction*

PERIRENAL HEMATOMA

See also *Subparietal Injuries of the Kidney* (p 2305)

Perirenal hematoma may arise from rupture of the kidney a bleeding diathesis or trauma The diagnosis is suspected on the appearance of an *increasing swelling* in the lumbar region There is also associated pain which is minimal in comparison with the size of the tumor If *aspiration* of the mass yields pure blood the diagnosis is confirmed and the specialist urologist should be consulted

If bleeding continues and the patient shows evidences of exsanguination it may be necessary to perform a *nephrectomy* Meanwhile supportive measures such as intravenous injections of fluids plasma and blood are instituted

RENAL INFARCTS

Infarcts of the kidney which are due to thrombosis and embolism of large vessels have already been discussed (p 2329)

Bilateral Cortical Necrosis —An unusual type of massive renal infarction is seen in the condition of bilateral cortical necrosis The origin of this condition is unknown but it is generally associated with the *puerperium* or with some debilitating infectious disease such as *tuberculosis* This profound disorder of the circulation of the kidney results in stasis and subsequent thrombosis It starts in the small vessels on the arterial side of the circulation and spreads toward the larger radicles The patient manifests *oliguria* or *anuria* with elevation of the nitrogenous metabolites of the blood There is no available *treatment* that is satisfactory although a continuous intravenous drip of hypertonic dextrose or sucrose solutions helps in the reestablishment of renal blood flow If renal function fails to return death supervenes within a few days

NEUROGENIC ABNORMALITIES OF THE URINARY SYSTEM

The component portions of the urinary system receive a rich innervation from the involuntary nervous system The renal arteries the muscular coats of the conducting channels the bladder and the sphincters of the urethra possess many connections with *cholinergic* and *adrenergic* subdivisions of the autonomic nervous system In each structure the two portions are mutually antagonistic In the excretory channels the cholinergic portion is apparently the more important but to the vascular system the adrenergic fibers are of great significance particularly in the condition of *essential hypertension* (p 900) Operative procedures have been devised to sever these pathways in order to ameliorate this frequent and disastrous condition (p 914) More tangible are the neurogenic abnormalities that involve the *bladder* and influence the mechanism of *micturition*

The urologist teaches the patient *manual methods of emptying the bladder* With persistent infection or retention and in the presence of dis tention or trabeculation it is wiser to attempt tidal drainage If this fails it becomes necessary to establish a *suprapubic cystostomy* *Overflow emptying* and *intermittent catheterization* invite complications

Therapy directed at the improvement of bladder function is disappointing For the cord bladder *resections of the presacral or hypogastric* nerve may favor a return to normal In transverse myelitis the estab lishment of an autonomic bladder is usually the best that can be anticipated

It is the responsibility of the practitioner to effect sterilization of the urine by chemotherapy (p 106) before instrumental investigation He maintains vigilance in preventing later bacterial invasion and institutes



Fig 557—Cystogram of tabetic bladder Note irregularity of bladder outline with multiple sacculations and dilatation of prostatic urethra with paralysis of internal sphincter Patient had an enormous retrovesical abscess which was drained per perineum (Case reported in the Jour Urol 1923 8[4] 323–338)



Fig 558—Cystogram illustrating an enormous bladder in a boy aged 9 years Patient appeared at clinic with statement that he voided once in 48 hours this was only complaint There was detrusor weakness incident to spina bifida occulta *

prompt therapy if it occurs He attempts to prevent stone formation (p 2319) but if he is unsuccessful he refers the patient to the urologist at a time when nonoperative removal is still feasible

* Herman The Practice of Urology

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CHAPTER III

INFECTIONS OF THE URINARY SYSTEM

INFECTIONS constitute the largest group of diseases of the urinary system The manifestations vary with the nature of the bacterial invader the pathogenic mechanism and the site of the inflammatory process *Urinary sepsis* is often complicated by *obstructive phenomena* and *lithiasis* It may lead to serious *nephropathy* and *hypertensive cardiovascular disease*

Bacteriology of Urinary Infection.—In the upper tract (kidney and renal pelvis) the commonest pathogens are bacilli of the *colon* group which are responsible for from 80 to 90 per cent of all renal suppuration Less often *staphylococci* and *streptococci* are encountered and a relatively small group of infections is caused by *tubercle bacilli* the *Bacillus proteus vulgaris Haemophilus influenzae Bacillus pyocyaneus* and *Pneumococci* Rarely encountered organisms are Friedlander's bacilli gonococci actinomyces and Treponema pallidum Mixed renal infections occasionally occur particularly in conjunction with tuberculosis

Infections of the *urethra* are most often gonococcal The intermediate *bladder* involvements which are usually secondary take on the character of the primary affliction

Pathogenesis—Pathogenic bacteria invade the urinary system by *hematogenous lymphatic* or *ascending urogenous routes* In the lower tract, the disturbances arise by contiguity while the upper tract is involved through the vessels or as an ascending invasion

The majority of primary infections of the upper tract are blood borne from an extra-urinary focus The *colon group* and *Friedlander's bacillus* usually gain entrance to the blood stream from the intestinal tract or a genital focus *Streptococcal* and *staphylococcal infections* follow acute upper *respiratory infections tonsillitis otitis media pneumonia* scarlet fever abscessed teeth or pyodermas *Renal tuberculosis is* usually secondary to a pulmonary lesion

The lymphatics are a possible channel for the passage to the kidney of bacteria from the bladder genital organs and intestinal tract The lymphatics of the ascending colon com-

municate with the capsule of the right kidney and ureter while those from the ascending colon drain into the capsule of the left kidney and ureter

Organisms gain entrance to the urinary passages through backward extension Occasionally a *retrograde infection* results from *instrumentation* of the urinary tract Infections of this type are usually secondary to infections of the urethra and bladder and are commonly caused by *gonococci B coli* and *B proteus*

Urinary infections which are complications of appendiceal abscesses subphrenic abscess psoas abscess Pott's disease of the spine or diverticulitis occasionally occur by direct extension from adjacent infected tissues More commonly the reverse is true and the urinary infection spreads by contiguity to the surrounding tissues as in *perinephric abscess*

Predisposing Causes—The occurrence of urinary infections is favored by mechanical obstruction intestinal disturbance and systemic influences

Mechanical Obstruction—Urinary obstruction produces stasis with a retrograde flow of urine bacteria may pass from the lower urinary tract to the kidney The provocative *urinary lesions* include congenital anomalies calculi tumors strictures neurological disorders and infections The *extra-urinary factors* which produce stasis are neoplasms of the perirenal and ureteral structures and the gravid uterus During pregnancy enlargement and rotation of the uterus angulates the lower end of the ureter particularly on the right Urinary drainage is impaired contributing to the frequency of renal infection during pregnancy

Bacteria enter the urine freely in systemic infections such as typhoid fever The bacilluria does not usually produce local inflammation unless there is also present some mechanical obstruction resulting in urinary stasis

Intestinal Disturbances—The clinical relationship of intestinal disturbances to acute renal infections is well established although the mechanism is far from clear Many acute kidney infections are preceded by an *acute gastroenteritis* (p 1848) and others occur in patients with *chronic constipation* Renal infections are especially common in infants with summer diarrhea *Intestinal spasmus (p 1846) is associated with a reflex spasm of the* smooth musculature of the urinary tract thus favoring urinary stasis

Systemic Influences—Systemic influences predispose to infections of the kidney and urinary tract Renal infections are common and of unusual severity in *diabetes mellitus* (p 1246)) The effect of *pregnancy* on ureteral drainage is discussed elsewhere (p 2333) *Hormonal influences* during pregnancy particularly that of progesterone secretion (p 2517) cause relaxation and dilatation of the ureters and ureterovesical orifices thus causing a retrograde flow of urine

Vitamin A deficiency (p 616) is attended by some degree of cornification of the epithelium of the urinary tract which favors calculus formation and infection These influences may explain the greater incidence of urinary infection in undernourished children Aside from pregnancy *sex seems to be an important predisposing factor due to the short urethra* of the female and the frequency of vesical sphincter dysfunction

The Effects of Infection—Aside from the obvious infectious disturbances associated with urinary sepsis inflammatory lesions of the tract favor *obstruction* the formation of *concretions* and the late production of *renal insufficiency*

Obstructive Phenomena—Obstructive phenomena result from edema and blockage of the lumen in the acute phases of the infectious process Later with scar formation *strictures* are formed and a more rigid blockage is established These factors create a vicious cycle since the infection which produces stasis is itself perpetuated by the presence of stagnant urine acting as a culture medium Thus the therapeutic approach does not rest wholly upon the amazing efficacy of *chemotherapeutic drugs* but must be supplemented and reinforced when necessary by instrumentation and surgery

Calculus Formation—In urolithiasis the situation parallels that of infection Bacteria may form the nucleus of a urinary concretion thus initiating the process while the concretion in turn creates inflammation and obstruction providing ideal circumstances for bacterial invasion Thought

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smears for *tubercle bacilli* is indicated in those who have tuberculosis or who have had sexual intercourse with a tuberculous suspect The survey is completed by making a hangdrop preparation for *Trichomonas vaginalis* (p 2496)

For Differential Diagnosis see *Urethral Discharge* (p 2340) *Vaginal Discharge* (p 2585)

Treatment—The treatment of nonspecific urethritis is unsatisfactory Local instillations and other therapeutic endeavors seem only to perpetuate the condition The administration of sulfonamides is wholly without value but a probatory course of sulfadiazine followed by penicillin is worthy of trial for lack of a better form of therapy Predisposing factors if present are eliminated and sexual hygiene is supervised and corrections made if necessary The sexual partner is examined for irritating discharges and treatment is instituted if they are present

Attempts to treat the condition by *local hyperpyrexia* using a specially devised chamber to house the penis are occasionally but not universally successful In the end it is often necessary to request the patient to accept the disability knowing that the condition will abate after several weeks or months Recurrences are to be expected and their treatment is equally unsatisfactory

SYPHILITIC URETHRITIS (INTRA URETHRAL CHANCRE)

The urethra is the site of a chancre in a reasonable number of instances of primary syphilis Very rarely it is involved in secondary and late lues

The principal clinical feature of the urethral chancre is a scant *seropurulent urethral discharge which is often blood tinged* The meatal lip may be swollen and protuberant and thickening of the under surface of the urethra may be felt The presence of a gonorrheal infection is naturally suspected but smears and cultures reveal no gonococci and it is not until a *darkfield examination* has been made that the condition is recognized *Endoscopy* may reveal a localized ulceration covered by a greyish exudate

With recognition of the lesion vigorous antisyphilitic therapy is instituted (p 340)

TUBERCULOSIS OF THE URETHRA

Tuberculosis of the urethra is a rare condition that is usually the result of an extension of a *tuberculous prostatitis* (p 2472) *seminal vesiculitis* (p 2267) or *cystitis* (p 2342) Contact infections during coitus or from infected urine or seminal fluid may be causative

Tuberculous urethritis begins in the posterior urethra and extends forward On *endoscopic examination* yellowish tubercles are seen surrounded by an inflammatory reaction Numerous punched out ulcers with ragged edges may be encountered and the deep extension of these lesions leads to the production of urinary fistulas A late sequel is the formation of a urethral stricture Biopsy of the tissue reveals areas of caseation tubercle formation and fibrosis

The *clinical manifestations* include painful urination burning frequency *painful erection and the presence of purulent urethral discharge* Examination reveals a palpatory thickening of the urethra with tender nodules along its course

ful management of these clinical afflictions requires *chemotherapy* preceding and following *mechanical treatment* (p 2254)

Renal Insufficiency—The most insidious aftermath of urinary infection is the development years and even decades later of *renal insufficiency* due to thinning or destruction of the parenchyma The wise practitioner in treating the obvious infection has an eye to the long range view of a later *nephropathy* (p 2362) Conversely, when confronted with a serious renal insufficiency he seeks the presence of some earlier infection that is still amenable to therapy

SPECIFIC BLADDER AND URINARY TRACT INFECTIONS

The many and variegated factors that are involved in urinary tract infections preclude the possibility of a thoroughly consistent presentation of this subject In some cases such as those caused by tuberculosis or gonorrhea the nature of the invading organism is of dominant significance on the other hand in cases such as nontuberculous upper tract infections it is the site of the disturbance that is of greatest concern

NONGONORRHEAL URETHRITIS

It is a clinical axiom that each urethral discharge is considered gonorrheal in origin until proved otherwise Nevertheless nongonorrheal urethritis exists and in our experience is much more commonly encountered than is generally credited

Nonspecific urethritis is often *primary* and unassociated with any other disturbance At times it appears as a *secondary complication* in patients who have an underlying prostatitis urethral stricture posterior urethral cyst urethral tumors narrowing of the urethral meatus impaction of a foreign body or a long tight prepuce The condition may arise from chemical and mechanical factors such as instrumentation the irritation of chemicals used in venereal prophylaxis sexual overindulgence chronic masturbation intercourse with a sexual partner who has an irritating discharge or from sensitivity to rubber condoms

Etiology and Pathogenesis—Nonspecific urethritis is suspected in each instance in which the practitioner encounters urethral infection without definitive recognition and isolation of the gonococcus The suspicion is fortified if the patient denies venereal exposure

Bacteriological studies of the discharge yield no significant findings Secondary invaders such as nonvirulent staphylococci are often found but the cause of the disease seems not to have been isolated This fact and the resistance of the infection to therapy have led to the suspicion that the disease is viral in its origin as in Reiter s disease (p 484)

Diagnosis—The presenting symptom of a nonspecific urethritis is the presence of a *mucopurulent discharge* There is no history of venereal exposure and careful examination of the urogenital system in association with a bacteriological survey fails to reveal evidences of chronic or acute gonorrhea before and after massage of the prostate *Endoscopy* is clearly indicated to establish the presence of some one of the predisposing factors enumerated in the paragraph on pathogenesis (p 2334) *Darkfield* microscopy of exudate is required if there is a suspicion that the lesion is the primary chancre of *syphilis* (p 3246) The examination of stained

smears for *tubercle bacilli* is indicated in those who have tuberculosis or who have had sexual intercourse with a tuberculous suspect The survey is completed by making a hangdrop preparation for *Trichomonas vaginalis* (p 2496)

For Differential Diagnosis see *Urethral Discharge* (p 2340) *Vaginal Discharge* (p 2585)

Treatment —The treatment of nonspecific urethritis is unsatisfactory Local instillations and other therapeutic endeavors seem only to perpetuate the condition The administration of sulfonamides is wholly without value but a probatory course of sulfadiazine followed by penicillin is worthy of trial for lack of a better form of therapy Predisposing factors if present are eliminated and sexual hygiene is supervised and corrections made if necessary The sexual partner is examined for irritating discharges and treatment is instituted if they are present

Attempts to treat the condition by *local hyperpyrexia* using a specially devised chamber to house the penis are occasionally but not universally successful In the end it is often necessary to request the patient to accept the disability knowing that the condition will abate after several weeks or months Recurrences are to be expected and their treatment is equally unsatisfactory

SYPHILITIC URETHRITIS (INTRA URETHRAL CHANCRE)

The urethra is the site of a chancre in a reasonable number of instances of primary syphilis Very rarely it is involved in secondary and late lues

The principal clinical feature of the urethral chancre is a scant *seropurulent urethral discharge* which is often blood tinged The meatal lip may be swollen and protuberant and thickening of the under surface of the urethra may be felt The presence of a gonorrheal infection is naturally suspected but spreads and cultures reveal no gonococci and it is not until a *darkfield examination* has been made that the condition is recognized *Endoscopy* may reveal a localized ulceration covered by a greyish exudate

With recognition of the lesion vigorous antisyphilitic therapy is instituted (p 340)

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The *treatment* of tuberculous urethritis involves attention to extra urethral foci In extreme instances the urinary stream must be diverted by a suprapubic cystostomy (p 2262)

TRICHOMONAL URETHRITIS

Trichomonas vaginalis occasionally invades the male urethra or lodges under a tight prepuce While it is difficult to determine which of the sexual partners has passed the infection to the other certain it is that unless both are cured reinfection is inevitable

The main *clinical manifestations* of trichomonal urethritis are itching and the presence of a mucopurulent urethral discharge There may be an associated prostatitis causing frequency, urgency, prostatic tenderness and swelling Bacteriological examination fails to reveal the presence of gonococci and microscopic examination of the fresh material discloses the trichomonas (p 2496)

Treatment consists of removing the focus underneath the prepuce by circumcision if necessary Urethral irrigations with mercury oxycyanide (1 4000) or acriflavine (1 3000) usually succeed in ridding the patient of his difficulty provided that he is not reinfected by his sexual partner

URETHRORRHEA

Urethrorrhea is not strictly an infection but rather an inflammatory condition involving the urethra and producing abnormal quantities of secretion The discharge is composed of mucus with only an occasional leukocyte or epithelial cell Often the condition is associated with a *spermatorrhea*

Urethrorrhea has clinical significance only in that it is suggestive of an infection particularly of gonorrhea and may be treated for a long period of time with the production of a superimposed chemical urethritis The condition is probably due to prolonged stimulation or irritation of the urethral mucous membranes by frequent masturbation prolonged erection congestion of the prostate gland chemical treatment of the urethra with astringents or the use of tight fitting or irritating condoms

The important principle of *treatment* is to direct the attention of the patient to the cause and assure him that he has had no noxious infection If active therapy is required the local area may be anointed with a simple protective ointment

GONORRHEAL URETHRITIS

The general discussion of gonorrhea infections is elsewhere detailed (p 217) The present material is limited to a consideration of the local inflammatory reaction by which the organism generally is introduced into the body

Pathology —The gonococcus is ordinarily introduced into the urethra and spreads by direct extension along the mucosal surface Thence it penetrates into the submucosal tissues and the urethral glands In the early stage the disease remains localized to the anterior portion of the urethra but, with the passage of time it tends to invade the posterior urethra prostate and seminal vesicles in the male and the cervix and fallopian tubes in the female Before the advent of systemic chemotherapy backward extension was favored by instrumentation attempted for therapeutic effect

The initial lesion is an acute inflammation of the mucous membrane which becomes diffusely reddened swollen and ulcerated The ducts of the urethral gland serve as foci for suppuration deeper extension and the perpetuation of a chronic urethritis As the acute inflammation heals the normal columnar epithelium is replaced by a more resistant pavement epithelium

Clinical Manifestations—The chief complaints in gonorrheal urethritis are burning and painful *urethral discharge dysuria* and *frequency of urination* The uncircumcised male may suffer from *paraphimosis* and the attention of the female is drawn to her disturbance by a *vaginal discharge* In the latter the condition is often unnoticed and may be revealed only by *some slight itching due to the presence of dried pus*

Examination reveals redness of the *external meatus* with swelling and *eversion of the lips* The *inguinal nodes* may be *tender and enlarged* In the male *erections* are painful Patients with a phimosis develop acute *inflammation and edema of the foreskin* with compression of the penis

While most patients have no observable constitutional manifestations others develop *slight malaise a low grade pyrexia and* moderate manifestations of *toxemia* Not the least of the difficulties are the *psycho emotional overtones* which combine a sense of guilt with a fear of discovery of the sexual misstep

Chronic Gonorrheal Urethritis (Gleet)—In the era that preceded the successful chemotherapy of gonorrhea chronic inflammatory complications were the rule rather than the exception *following an acute urethritis The* principal causes were inadequate therapy and overzealous instrumentation *during the acute phase* The principal *pathological findings* included posterior urethritis residual foci of infection in the para urethral ducts and glands infiltrations and thickenings of the urethral wall urethral strictures and persistent involvement of the genital structures (p 2467) These produced recurring urethral discharge glueing of the urethral lips and the *finding of purulent* or mucopurulent shreds in the first second or third glasses of the differential tests (p 3666) While the shreds rarely revealed the organism the catheterized urine often yielded the gonococcus by cultural methods

Diagnosis—The diagnosis of gonorrheal urethritis is a laboratory discipline No matter how astute the clinician he errs if he commits himself as to the etiology of the disturbance without examination of bacteriological smears and cultures See *Nongonorrheal Urethritis* (p 2336)

The technic of preparing and examining bacteriological smears and cultures *is* elsewhere described (p 219) *Specimens are obtained directly* through the urethra of the male but in the female they should be taken from both the vaginal discharge and the cervix

For Differential Diagnosis see *Urethral Discharge* (p 2340) *Vaginal Discharge* (p 2585)

Local Complications—Complications of gonorrheal urethritis may be local or systemic and they differ in male and female

In the Male—*Posterior urethritis* occurs in about 50 per cent of men infected with gonorrhea Ordinarily the spread results from instrumentation *and inadequate therapy Usually* the posterior urethra becomes infected during the second week of the disease but it may occur within a few days after onset *The condition is heralded* by an increase in the fre

quency and urgency of urination A terminal hematuria may be produced There are frequent erections, priapism and chordee Once the posterior urethra is infected it is almost a certainty that the *urethral glands prostate seminal vesicles* and *epididymides* will also be involved Healing frequently leads to *stricture formation* (p 2299)

Parafrenal abscess involving Tyson s glands occurs infrequently in the course of a gonorrheal urethritis The condition is detected by the presence

DIFFERENTIAL DIAGNOSIS OF

Urethral Discharge

The presence of a urethral discharge in male or female arouses the suspicion of gonorrheal infection Examinations must be made by smear and culture since the latter may be positive when organisms are not demonstrable microscopically

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Gonorrheal Urethritis	With demonstration of gram negative diplococci by smear or culture (p 217)
Nonspecific Urethritis	*Probably a virus infection* with pathogens not demonstrable by smear or culture
Reiter s Disease	With conjunctivitis and arthritis (p 484)
Urethral Stricture	Chronic discharge which may be gonorrheal or non-gonorrheal Make smears and cultures (p 50) Refer to specialist for urethroscopy (p 2247)
Syphilis	Intra urethral chancre with positive darkfield (p 47)
Tuberculosis	Ulceration may follow ritual circumcision. *Look for acid fast organisms in exudate* and biopsy (p 49)
Trichomonas	Usually with nest under tight foreskin Demonstrate organisms by direct spread (p 2496)
Phimosis	Irritation from tight foreskin.
Paraphimosis	Edema of foreskin associated with infection usually venereal (p 2339)
Balanoposthitis	Irritation of glans usually associated with venereal infection (p 2339)
Preputial Calculi	Irritation from stones impacted under tight foreskin
Seminal Vesiculitis and Prostatitis	With increase of discharge following prostatic massage by rectum.
Spermatorrhea	*Discharge containing sperm* but no leukocytes

of small abscesses on either side of the frenum displacing it to the opposite side The tender swelling usually remains well localized but may rupture into the urethra and aggravate the initial infection

Peri urethral abscess becomes apparent as a small tender nodule on the under surface of the shaft of the penis or in the midline of the perineum at the penoscrotal junction The swelling is acutely painful and tender and may obstruct the urethral canal In all likelihood the peri urethral abscess is initiated or aggravated by overforceful instrumentation and chemical

irritation Occasionally the abscess ruptures and produces a permanent *urinary fistula*

Infections of the *bulbo urethral glands of Cowper* are rare and are elsewhere described (p 2469) The chief manifestations are perineal pain and the appearance of a rounded tender swelling at one side of the perineal raphe behind the urethral bulb The abscess tends to point to the perineum and may produce a *urinary fistula*

The genital complications of gonorrhea in the male are elsewhere discussed These include *balanoposthitis* (p 2454) *paraphimosis* (p 2427) *balanitis* (p 2454) *cavernositis* (p 2454) *prostatitis* and *prostatic abscess* (p 2470) *seminal vesiculitis* (p 2467) *orchitis* (p 2464) and *epididymitis* (p 2461)

In the Female —The local complications in the female are usually limited to the genital system They include *bartholinitis* (p 2587) *skeneitis* (p 2586) *cervicitis* (p 2600) *vaginitis* (p 2600) *salpingitis* (p 2608) and *pelvic peritonitis* (p 1950) Less often there may be *oophoritis* and *endometritis* (p 2607) The sequels in the urinary tract are in the nature of the formations of *strictures caruncles papillomas* and *condylomas*

The Systemic Complications —The systemic complications of gonorrhea identical in male and female are elsewhere discussed See *Gonorrheal Endocarditis* (p 1020) *Arthritis* (p 2905) *Tenosynovitis* (p 2901) *Iritis* (p 1621) *Meningitis* (p 1470) and the *Dermatoses* (p 3355)

Treatment —The management of gonorrhea is aimed at prevention and cure The modern attack upon gonorrhea has all but superseded the older relatively feeble and prolonged measures of local and topical application Systemic chemotherapy with *sulfonamides* and *penicillin* and *hyperthermia* have relegated to the realm of medical history the irrigations instillations and instrumentations of days gone by To stress the concept of the systemic importance of gonorrhea and its therapy the details of management are included in the section on *Infectious Diseases* (p 221)

TUBERCULOSIS OF THE BLADDER

See p 2349

SCHISTOSOMIASIS OF THE BLADDER (BILHARZIASIS)

Infection of the genito urinary organs by the *Schistosoma* is frequent in Egypt Arabia South Africa India and China Although any portion of the urinary system may be involved the parasites (p 540) usually localize in the bladder wall

Pathology —The *larvae* after entering the body by piercing the skin mature in the vesical veins *Ova* are laid in large numbers by the female and pass into the subepithelial connective tissue of the bladder Provided with a sharp spine they cause great local irritation ulcerate through the mucosa and escape into the urine The bladder mucosa becomes thickened by granulation tissue and many *vascular papillomas* are formed In the late stages there is extensive *fibrosis* leading to contraction of the vesical wall Localized areas of *calcification* are common and *calculi* frequently form with an ovum as a nucleus Urinary fistulas urethral strictures and prostatic seminal or testicular involvements may occur Secondary bacterial infections are common and give rise to *ascending renal sepsis* in which the bilharzial lesions are found in the ureter and renal pelvis In advanced instances the disease involves the entire bladder but usually it is limited to the region of the trigone posterior bladder wall and ureteral orifices *Carcinoma* is a common secondary development exemplifying the relationship of malignancy to chronic irritation

Clinical Manifestations —The clinical manifestations of vesical schistosomiasis are those of an intense cystitis *Hematuria* is the initial symptom and is painless in early and mild infections As ulceration increases and pyogenic infection supervenes, the suffering becomes intense Death is due to a combination of renal failure toxemia and anemia

Diagnosis —A positive diagnosis of schistosomiasis is made by finding the typical *ova* (p 540) in the *urine* or in the *tissue* biopsied from the vesical wall Cystoscopy reveals small yellowish nodules on the posterior wall and about the ureteral orifices Later there may be numerous ulcers papillomas and incrustations with a great thickening of the bladder wall and a contraction of its cavity

Treatment —The treatment of vesical schistosomiasis is elsewhere discussed (p 538) Main reliance is placed on systemic injections of *antimony compounds* (p 132)

ECHINOCOCCUS DISEASE OF THE BLADDER

See p 2351



Fig 559.—Several types of lesions due to vesical bilharziasis *

VESICAL AMEBIASIS

The *Endamoeba histolytica* (p 523) may invade the urinary tract and give rise to an intense cystitis The organisms spread via the lymphatic and hematogenous channels from the intestinal tract

The principal manifestations are frequency pyuria dysuria and hematuria Motile amebas and cysts are found in the urine The bladder mucosa on cystoscopic examination appears diffusely reddened and in the region of the trigone there are large undermined ulcers

Vesical amebiasis is treated in the same manner as intestinal infestations (p 527)

NONSPECIFIC CYSTITIS

Although the primary bladder lesions are rare secondary cystitis is frequently encountered as a result of downward spread of infection from the kidney and backward extension from the urethra

Bacteriology —The organisms present in a cystitis are for the most part those that are provocative of more fundamental infections In descending

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infections from the kidney the common invaders are *B coli streptococci staphylococci B proteus* and the *tubercle bacillus* Retrograde invasions from the urethra introduce the *gonococci*.

Pathogenesis —The normal bladder is highly resistant to bacterial invasion In the presence of urinary stasis or a foreign body however excellent cultural conditions are provided for bacterial growth Thus the common predisposing causes of cystitis include instrumentation the presence of a foreign body such as a calculus trauma incidental to the pressure of a pregnant uterus overenthusiastic instrumentation the presence of a neoplasm or a diverticulum atony from a neurogenic disorder and retention of urine from any cause

Pathology —A variety of acute and chronic lesions are encountered in bladder infections The variations depend on the type of organism and the mode of infection

Acute Cystitis —Acute cystitis may be generalized or localized to the region of the trigone and vesical neck The involved mucosa appears intensely red and swollen The inflammatory reaction remains superficial and rarely invades the vesical musculature There may be numerous areas of hemorrhage and superficial ulceration with deposits of fibrin Microscopically the blood vessels are dilated and congested The submucosa and mucosa are edematous and extensively infiltrated with leukocytes Many areas of necrosis ulceration and bulla formation may be present These changes may resolve completely or go on to chronicity

Chronic Cystitis —In chronic cystitis the entire bladder wall is usually involved and there may be an extensive *pericystitis* The vesical wall is thickened and inelastic and the capacity of the lumen is reduced The mucosa assumes a gray dull appearance with dilatation of the submucosal blood vessels Areas of edema, ulceration cornification and pseudomembrane formation are present Microscopically there are extensive areas of round cell infiltration small abscesses and replacement fibrosis The changes in *vesical tuberculosis* are described in the chapter *on urinary tract tuberculosis* (p 2347)

A number of special anatomical types of chronic cystitis have been delineated on the basis of the pathologic and cystoscopic findings *Cystitis nodularis or follicularis* is characterized by subepithelial lymph follicles within the mucosa In some areas especially over the trigone and base of the bladder the nodules are so closely packed that they appear confluent The condition is common in women and is believed to result from a chronic colon bacilluria *Cystitis cystica* is a definite entity in which there are numerous small subepithelial cysts It is usually associated with ureteritis cystica and pyelitis cystica Microscopically the mucosa contains many cysts lined by a single layer of epithelium and containing a clear fluid *Cystitis granularis* arises from a metaplasia of the bladder epithelium with the formation of mucous and goblet cells as seen in the small intestine Frequently these glands become occluded and give rise to cysts This condition is related closely to cystitis cystica *Cystitis emphysematosa* is marked by the presence of numerous small gas-filled cysts in the mucosa The cause is unknown but it is believed to be a result of *B coli* infection The gas vesicles have never been observed cystoscopically but are present at autopsy suggesting that this is a postmortem finding *Pseudomembranous cystitis* is usually limited to the trigone and appears as a grayish pink adherent membrane with rolled up edges *Leukoplakia* of the bladder presents cornification and thickening of the bladder mucosa with a histological appearance resembling the epidermis It is usually due to severe chronic infection *Incrusted cystitis* is characterized by calcium deposits in the vesical mucosa, usually in areas of ulceration It is frequently present in infections due to *B proteus* and other organisms capable of splitting urea into ammonia The alkalinity of the urine favors the precipitation of calcium salts *Gangrenous cystitis* results from local interference with the vesical blood supply leading to areas of superficial and deep necrosis It is not uncommon during parturition due to the pressure of the fetal head There may be extensive areas of adherent necrotic mucous membrane (diphtheritic cystitis) *Interstitial cystitis (Hunner's ulcer)* is a fairly definite pathological entity of obscure etiology It occurs as a localized area of chronic inflammation involving all the coats of the bladder usually on the vesical dome The acute lesion is characterized by round-cell infiltration of the submucosa and epithelialization of the mucosa Healing results in a dense fibrous scar which produces contraction of the bladder and mucosal cracks

Clinical Manifestations —The common symptoms of cystitis are *pain on urination frequency urgency* and *nocturia* The pain is usually present in

the region of the bladder and urethra It may radiate to the groin and perineum and is usually worse at the end of urination It is generally of a cramping nature due to spasmodic contractions of the vesical muscle Frequency may be present as a constant desire to urinate or it may be recurrent at varying intervals The urgency bladder pain and nocturia rapidly lead to extreme exhaustion and weight loss There is often a low grade fever but in certain instances as in gangrenous cystitis the temperature is septic in type

The urine contains traces of albumin varying amounts of pus epithelial and red blood cells In acute cystitis a terminal hematuria is quite common Urine cultures reveal the causative organisms

Diagnosis —The diagnosis of cystitis is suspected from the history and confirmed by microscopic and bacteriologic examinations of the urine Cystoscopy is of paramount diagnostic value but should be avoided during the acute stage Since cystitis is so frequently secondary it is important to investigate the coexistence of such lesions as pyelonephritis infected hy

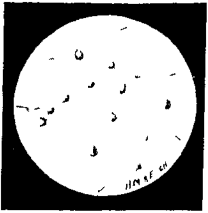


Fig 560 —Mild cystitis cystica *

dronephrosis prostatitis prostatic hypertrophy urethral stricture vesical diverticula calculi neoplasm neurogenic disorders adnexal disease or gastro intestinal disorders Tubercle bacilli should be carefully sought by means of stained smears and animal inoculation Schistosomes and amebas are revealed by direct examination of fresh material

For Differential Diagnosis see *Dysuria* (p 2325), *Frequency of Urination* (p 2310) *Pyuria* (p 2352)

Treatment —The problem of therapy in bladder infection or inflammation is exceedingly complicated It involves symptomatic relief the elimination of bacterial infection special forms of local therapy upon indication and efforts to deal with the primary causative disturbance

Symptomatic Treatment —The patient with an acute vesical infection is best kept *in bed* at complete rest Considerable relief from pain is obtained by the use of *moist heat* to the bladder and perineal regions Hot towels sitz baths colon irrigations and douches may be employed

A bland *diet* is prescribed *alcoholic beverages* and *spicy foods* are

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avoided and large amounts of *fluids* are administered The *bowels* require thorough evacuation While many urologists favor the administration of a vigorous purgative such as castor oil we are inclined to believe that drastics are of more potential harm than value In consequence we prefer the administration of an *enema*

Severe pain is relieved by *antispasmodics* (p 3875) fortified with *sedatives* or *opiates* The newer atropine-like preparations are preferred and *novatropine* *trasentin* or *syntropan* is prescribed together with a *barbiturate*

℞		
	Novatropine	0.030
	or	
	Trasentin	1 0
	or	
	Syntropan	0.8
	with	
	Sodium phenobarbital	0.25
	Lactose	q s ad 5 0
	Divide	
	Make 15 capsules	
	S g One q 4 hrs as directed	

With greater distress an *opiate* is substituted for the barbiturate in the above prescription or *demerol* (p 3863) is given in doses of 50 to 100 mg

Antibiotic Therapy—The treatment of cystitis has been greatly simplified since the introduction of antibiotics Streptomycin is most effective against coliform bacilli *A aerogenes B proteus* and *Ps aeruginosa* though organism resistance may rapidly develop *Sulfonamides* and *penicillin* show greatest efficacy in combating coccal infections When the pathogen cannot be identified blanket coverage is obtained by combining sulfonamide or penicillin with streptomycin (p 104) Of the remaining bactericides only *calcium mandelate* (p 2256) is worth consideration

Local Therapy—The patient with *acute cystitis* should not be subjected to instrumentation

Chronic lesions are often influenced favorably by bladder irrigations and transcystoscopic manipulations Bladder irrigations are best performed with 4 per cent boric acid solution sterile water 0.5 to 1 per cent acriflavine 1 5000 silver nitrate solution 10 to 15 per cent mild silver proteinate or 1 20 000 bichloride of mercury solution

Ulcers such as are found in the chronic types of *interstitial cystitis* (p 2343) are treated through the cystoscope with topical applications of stronger solutions of *silver nitrate* *Fulguration* (p 2263) is practiced on papillomas Instillations of 1 per cent *silver nitrate* are made after local anesthestization with 4 per cent metycaine

Treatment of Predisposing Cause—In the presence of a cystitis the practitioner must never rest content with treatment directed at the bladder alone Cystoscopy (p 2248) usually reveals the presence of more fundamental abnormalities in the *urethra* or *bladder neck* There may be *tumors* or *stones* in the bladder itself *urinary retention* or *stasis* The upper urinary tract is explored by retrograde and intravenous urography

and pyelography Differential specimens are obtained from each ureter After miscroscopic examination cultures are made and stains prepared for seeking the presence of the *tubercle bacillus* (p 49)

With an encrusted cystitis the urine is acidified by the systemic administration of *ammonium chloride* (p 614) or *calcium mandelate* (p 2256) The bladder is lavaged with 1 per cent *phosphoric acid* or a *buffer citrate solution* (p 2320), using an indwelling catheter

Surgery—In gangrenous and other severe grades of cystitis it may be necessary to perform a *suprapubic cystostomy* (p 2263) Meantime, supportive therapy is administered including chemotherapy bladder irrigations and intravenous infusions of saline glucose plasma or whole blood

URETERITIS

Infections of the ureters are usually secondary and incidental to those of the kidneys and bladder The manifestations merely contribute to the general symptomatology and require no special therapeutic endeavors In a few instances chronic ureteral changes dominate the clinical picture

Ureteritis Cystica—Ureteritis cystica is characterized by the presence of numerous small cysts in the mucosa of one or both ureters It is usually seen in conjunction with *cystitis cystica* (p 2343) Although the etiology is not clear there is consensus of opinion that the cystic changes are the result of chronic irritation and infection

The symptoms of ureteritis cystica are those of the underlying cause such as the presence of a *ureteral calculus* or *chronic infection* of the kidney or bladder Rupture of the cyst causes *hematuria* and a large cyst may obstruct the lumen and produce a *hydronephrosis* The *diagnosis* is made by the expert after retrograde and intravenous pyelograms which show multiple filling defects in a dilated tortuous or constricted ureter

Treatment is directed at the underlying cause Large cysts may be ruptured by an indwelling catheter however after which a solution of ½ per cent silver nitrate should be instilled locally

Inflammatory Ureteral Strictures (Hunner)—Inflammatory ureteral strictures occur as the result of metastatic infection or extension by continuity Hunner the most enthusiastic advocate of the former hypothesis believes that ureteral strictures follow hematogenous infection borne from infected tonsils teeth or nasal sinuses The majority opinion based on *the fact* that most inflammatory strictures are found in the lower third of the ureter favors the view that the lesion is due to direct extension of infection to the ureteral wall from a diseased bladder prostate gland or adnexal inflammation

The recognition of the ureteral stricture depends upon an investigation of one of its complications such as *stone formation hydronephrosis* or *pyelonephritis* The stricture is detected by the expert during retrograde pyelography and ureteral catheterization

Treatment consists of dilatation using progressively larger ureteral catheters and bougies

Leukoplakia—Leukoplakia of the ureter is rarely a localized condition but is usually associated with similar changes in the renal pelvis and bladder (p 2343) It results from long standing infection or irritation which produces an epidermoid metaplasia of the mucous membrane

Treatment consists of removal of the cause Large doses of *vitamin A* (p 620) have been recommended in order to alleviate the cornification

Tuberculosis of the Ureter—See p 2349

RENAL TUBERCULOSIS

Renal tuberculosis is a common affliction of the urinary system It progresses slowly from its initial kidney focus to the ureter bladder and genital organs Early recognition of the renal focus is of signal importance



A B

Fig 561—Illustrating case of unilateral renal tuberculosis with stricture of distal end of ureter which mimicked invisible ureteral calculus Patient a woman aged 38 Sole complaint severe renal pain (L) Intravenous urography disclosed a dilated kidney (L) Ureter closed at distal end to catheters on several occasions Catheterization finally successful Retrograde pyelogram *A* disclosed renal tuberculosis and ureteral strictures (tuberculous) Tubercle bacilli demonstrated in urine from left kidney Nephrectomy successful Specimen *B* shows lesion confined to site of pyelographic defect

since nephrectomy at this stage of the disease is curative in unilateral involvement

Etiology and Pathogenesis—Tuberculosis of the urinary tract is most always hematogenous in origin The *primary lesion* is extra urinary and usually in the lungs or mediastinal lymph nodes When the primary focus breaks down bacilli are liberated directly into the pulmonary vein These lodge in the renal parenchyma and are capable of producing a *chronic progressive destruction* of the involved tissue At the same time *additional foci* may be set up in the genital organs (pp 2462 2610)

* **Herman, The Practice of Urology**

The disease is rare before puberty and in patients over fifty Not uncommonly it occurs in association with active tuberculosis in other organs such as the lungs bones and joints

Pathology—Tuberculosis is essentially a disease of the entire urinary system Although the kidneys are usually involved first by the time the disease is recognized clinically the ureters and bladder are affected by extension of infectious process At the onset it is probable that both kidneys are involved However the disease usually progresses more rapidly on one side while the contralateral kidney remains in a state of quiescence and may even heal spontaneously after removal of the more extensively involved organ



Fig 562—Bilateral pyelogram showing extensive tuberculous ulceration of the pelvic walls (L) the latter as a whole being enlarged Note marginal feathering and blunting of the calices There is no parenchymal cavitation Right kidney is normal Patient, a male aged 26 Nephro ureterectomy successful *

The Kidney Lesions—The earliest active renal focus is commonly located in the *medulla* at the base of a renal pyramid The cortex is more resistant to the infection and is involved fairly late by extension of the medullary process In an early stage the involved kidney appears normal externally On cross section a solitary lesion is seen in the region of the papilla This tubercle is edematous swollen and covered with yellowish nodules and ulcerations It tends to spread in all directions but to the greatest extent toward the pelvis

When the disease is moderately advanced the kidney appears enlarged and may be transformed into an irregular multiloculated organ whose surface presents yellowish tubercles and dark infarcted areas The medulla is riddled with cavities between which are white caseous areas Many of the cavities communicate with the renal pelvis As is true of pulmonary tuberculosis the communication of a parenchymal focus with a canalicular or duct system is an important factor in the dissemination of the disease Once the pelvis is involved, there is invariably some degree of *ureteritis* The ureter becomes thickened indurated and rigid The pyelo-ureteral junction may be stenosed with the production of some degree of hydronephrosis The coexistence of multiloculated cavities and areas of caseation at this stage of the disease has led to its pathological designation as *cavernocaseous*

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The late stages are marked by extensive renal destruction The parenchyma is reduced to a thin shell enclosing an irregular pyonephrotic sac although in some instances the organ is extensively fibrosed and calcified The perirenal tissues are infiltrated by firm thick fibrous tissue The renal pedicle and the kidney are transformed into one large mass

Changes in the ureter and bladder parallel the progress of the disease in the kidney and are responsible for many of the important clinical features of the disease

Ureteral Lesions—Involvement of the ureter follows quickly upon the spread of the disease to the renal pelvis The vesical end of the ureter is usually affected first by a diffuse ureteritis followed by tubercle formation and ulceration The lumen becomes obstructed and dilated Finally the whole length of the ureter is involved and transformed into a rigid tube The lumen becomes alternately narrowed and dilated and there is considerable obstruction to the flow of urine—factors leading to hydronephrosis and pyonephrosis



A B

Fig 63—V y ea ly e al tube culos n the upper half of a kidney w th b fid pel is Patient a young nurse was admitted for pulmonary study There was slight evening rise of temperature loss of weight an x a and sweating Urine contained a few leukocytes bl d de was normal *The pyelogram A shows a bifid pel is lower half of which is normal The* upper most calyx is feathered the one next to it ulcerated and in communication with a parenchymal ca ity *B* Note two small ca ities This kidney was normal in function and d l red clear urine containing a few leukocytes and tubercle b cilli This is the earliest case of renal tuberculosis operated upon by the author Patient is alive and well 9 years after operation

Bladder Lesions—The first d n s f ve cal ol ment are seen about the orifice f the ffected ureter The initial lesions ar sm ll tubercles which may be arranged circu l rly about the ureteral orifice These form oval o ounded flat ulcers with grayish white bases and u de mined edges The ent e bl dd w ll may become infiltrated and the fibrous reaction results n a marked d gr e of ve al contraction The bladder is also involved by the spread of the disease from the genital organs which commonly participate in the tuberculous process

Miliary Lesions—In addition to chronic progressive tuberculosis the kidneys ureters and bladder may be involved in an acute miliary tuberculosis The small intrarenal blood vessels are obstructed by clumps of organisms and produce small tubercular infarcted areas This lesion may regress e t relv

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Clinical Manifestations—Despite extensive involvement of the urinary system the patient may suffer neither symptoms nor impairment of general well being Most commonly the initial complaints are referable to the bladder and consist of *frequency of urination urgency nocturia nocturnal incontinence* and *terminal dysuria* At times severe cramplike suprapubic *pain* is noted at the end of micturition *Hematuria* is commonly observed and is the presenting complaint in perhaps 5 per cent of all patients The bleeding may be brisk due to the erosion of a blood vessel or it may be occasional and recognizable only on microscopic examination

Physical examination yields little information of diagnostic value Occasionally the more extensively involved kidney is palpated as a somewhat enlarged and tender viscus *Costovertebral tenderness* may be elicited on percussion In the male the epididymis seminal vesicles or prostate gland may feel hard and nodular when they are involved in the inflammatory process In the female a mass may be palpable in adnexal regions due to a salpingitis (p 2616)

Attacks of *renal colic* are experienced when larger fragments of infected tissue pass into the ureter Occasionally attention is drawn to the local lesion through the manifestation of an acute or subacute *pyelonephritis* (p 2353) due to secondary infection Less often suspicion is aroused by the presence of a persistent *lumbar sinus* after drainage of an area of perinephric suppuration (p 2359)

Diagnosis—The diagnosis of genito urinary tuberculosis is essentially a laboratory discipline At most the clinician suspects the presence of the lesion from the history and physical examination

The *urinary findings* are of the greatest importance The freshly voided urine is acid and appears cloudy if there is a pyuria or smoky from contamination with blood cells A small amount of albumin is demonstrable and miscroscopy reveals the presence of many white blood cells and a varying number of red blood cells In approximately 85 per cent of all genito urinary infection the *tubercle bacillus* is demonstrable on a stained smear of the urinary sediment that is obtained after centrifuging (p 3690) It may be necessary to search the preparation for several hours before concluding that the examination is negative *Animal inoculation* may yield positive information when the microscopic hunt has proved futile

Tests of *renal function* remain quite normal unless there is an advanced bilateral involvement Except for an anemia in the late stages there are no characteristic blood findings

Radiography—Intravenous urography provides information that strongly substantiates the diagnosis of renal tuberculosis The renal shadow appears irregularly enlarged Areas of *calcification* are present in 5 to 30 per cent of the films These occur in the kidney spleen mesenteric lymph nodes or adrenal glands The *calices* appear moth eaten and compressed and *cavities* may be demonstrable Retrograde pyelography which best delineates cavitation is technically difficult because of narrowing of the ureters and is not without the hazard of the initiation of miliary dissemination

Cystoscopy—The earlier cystoscopic changes of urinary tuberculosis appear about the *ureteral orifice* of the involved kidney The lips appear injected and swollen and later become irregular prominent and rigid A

more advanced appearance is that in which the ureteral orifice is crater like and retracted (*golf hole appearance*) Small tubercles ulcerations and areas of exuberant granulation surround the involved opening and spread to the adjacent bladder wall In the more advanced vesical involvements the capacity of the bladder is reduced the mucous membrane is diffusely reddened and rugous the organ may be so irritable and sensitive that the cystoscopic examination requires the induction of general sacral or spinal anesthesia

The cystoscopic findings are often difficult of interpretation A *normal* appearing ureteral orifice on the contralateral side does not necessarily mean that the corresponding kidney is not also involved Conversely tubercular changes involving both openings may not connote bilateral renal tuberculosis since the orifice on the unaffected side may have become contaminated by direct vesical extension from the infected side The final word on the extent of the tuberculous involvement rests on *ureteral catheterization* Urine is separately collected from each kidney and examined bacteriologically by smear culture and animal inoculation

For Differential Diagnosis see *Frequency of Urination* (p 2310) *Dysuria* (p 2325), *Hematuria* (p 2306) *Pyuria* (p 2352)

Treatment—In early unilateral renal tuberculosis *surgical removal of the affected organ* produces a permanent cure in 80 to 90 per cent of patients This fact alone suffices to emphasize the importance of accurate diagnosis and prompt intervention A *nephrectomy* is performed if the ureter appears normal but with the slightest suspicion or evidence of extension a *ureteronephrectomy* is required

Those patients who have bilateral involvement in which one of the kidneys is disproportionately diseased are often benefited to a surprising degree by the removal of the more involved organ In such instances there is always the hope if not the possibility that the remaining kidney will heal completely and even bladder lesions may improve Extensive tuberculous cystitis however militates strongly against any possible operative improvement but streptomycin therapy merits trial

Following operation the patient is regarded as tuberculous and must continue the general methods of therapy elsewhere outlined (p 266) There is always the hazard of a flare up in the remaining kidney acute miliary tuberculosis may be encountered and the lesions in the genital tract are a constant source of danger

Before and after operation streptomycin and/or sulfonamide is administered for prophylactic chemotherapy (p 106) Certainly one method of preventing exacerbation of tuberculous infection is the avoidance of secondary bacterial contamination Conversely the superimposition of a non tuberculous inflammatory process favors extension of even a quiescent tuberculosis

ECHINOCOCCUS DISEASE OF THE KIDNEY AND BLADDER

An *echinococcus cyst* (p 1983) may develop at the upper or lower pole of the kidney The size of the tumor may vary from a small egglike structure to one as large as a child s head The surrounding renal tissue undergoes a pressure atrophy which may result in complete destruction of the secreting surface of the organ

The earliest manifestation of echinococcus disease of the kidney is the presence of a tumor in the loin and attacks of *renal colic* when the *scolices hooklets* and portions of the *membrane* pass down into the ureter Approximately 50 per cent of patients experience a rupture of the cyst which may break into the renal pelvis the peritoneal cavity the intestinal tract the pleura or the lung

Rupture of the Cyst—Rupture of an echinococcus cyst is usually attended by anaphylactic phenomena including a high *fever* with *chills* and

DIFFERENTIAL DIAGNOSIS OF

Pyuria

The origin of pus in the urine may be revealed by the two- or three-glass te t. An initial pyuria with clearing in the later specimen points to an inflammatory condition in the anterior urethra With terminal pyuria and a clear initial specimen, there is probably inflammation in the prostate and seminal vesicles Total pyuria is found with purulent suppuration in the bladder or upper urinary passages

As in the case of hematuria pyuria may be constant or intermittent It may or may not be associated with pain In any event the symptom is compelling and requires complete elucidation by the practitioner and consultant urologist In the female admixture with vaginal secretions may give a misleading appearance clarified by comparative examination of the catheterized specimen

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Urethral	Urethritis of gonorrheal or non-gonorrheal origin (p 2336) Cowperitis with enlargement and swelling of bulbo-urethral glands (p 2469) Obtain spreads and cultures (p 50)
Cystic	Cystitis and diverticulitis (p 2343) Obtain specimen by cystoscopy (p 2248) Examine smears and cultures (p 50) Prepare for injection into guinea pigs (p 63)
Renal	Acute and chronic pyelonephritis (p 2353) Tuberculosis furunculosis carbuncle and pyonephrosis of kidney (p 2356) Refer to urologist for urography and catheterization of ureters Examine differential specimens by mear culture carbolfuchsin stain and injection into guinea pigs (p 63) With perinephric abscess note obliteration of psoas shadows in x ray
Genital	Verumontanitis eminal vesiculitis and prostatitis in the male Supplement rectal examination with posterior urethroscopy (p 2247)

a generalized *urticarial eruption* The diagnosis is established by finding *hooklets* and *scolices* in the urine and by a rather characteristic radiographic appearance of a rounded and calcified shadow resembling a billiard ball in the renal area Pyelography reveals a filling defect and compression of the calices

Treatment—The treatment of echinococcus disease of the kidney is by *immediate operative intervention* before rupture occurs The procedures are technically difficult and consist of removal of the cyst with obliteration of

the cavity nephrectomy heminephrectomy or marsupialization and evacuation

Rarely the echinococcus disease involves the bladder secondarily to renal involvement Under these circumstances operative interference is much more difficult and the promise of a successful result is sufficiently remote to indicate a policy of watchful waiting

ACUTE PYELONEPHRITIS (PYELITIS)

Acute pyelonephritis is a febrile disease that is commonly seen in infants and young children during pregnancy and in older men with prostatic hypertrophy It is probably the most common disease of the urinary tract

Pathology—The mildest type of pyelonephritis is termed pyelitis a misleading designation since the inflammatory process is rarely confined to the renal pelvis One or both kidneys may be involved and the lesions are the same regardless of the nature of the invading organism or the origin of the process The kidneys may appear normal or swollen but beneath the capsule which strips easily are many small yellow abscesses The mucosa of the renal pelvis is usually is injected and there may be small submucous hemorrhages On microscopic examination the inflammatory process may be limited to the pelvis and collecting ducts but more often there are small interstitial abscesses and areas of diffuse inflammation In diabetics extensive gangrene of the renal papillae is encountered

More severe involvement is attended by swelling of the kidneys whose surfaces reveal many small yellow abscesses and irregular dark areas On cross section the latter appear wedge-shaped due to the spread of infection from the renal pelvis to the cortex by way of the tubules and peritubular lymphatics Microscopic examination shows typical abscess formation in the interstitial tissue Leukocytes are seen in the periglomerular lymphatics and within the glomeruli Clumps of bacteria are often present in the interstitial tissue and in the tubules

Clinical Manifestations—Pyelonephritis is common *in infants and young children* in whom it is usually associated with intestinal disturbances acute upper respiratory infection or the exanthems Girls are almost exclusively affected possibly because of the short female urethra which predisposes to ascending infections from soiled diapers and underclothes

During *pregnancy* acute pyelonephritis sometimes occurs during the second half of gestation and almost always affects the right kidney due to a dilatation of the upper urinary tract resulting from the tendency of the enlarging uterus to rotate to this side In old patients acute pyelonephritis is usually associated with obstructive lesions of the lower urinary tract such as prostatic hypertrophy urethral strictures and bladder tumors It is apt to follow diagnostic instrumentation in rare instances the disease is noted in females after sexual intercourse

The onset of an acute or recurrently acute pyelonephritis is usually heralded by a rapid *elevation of temperature* preceded by *chilly sensations* or a frank chill Some degree of pyrexia is invariably present Often the elevation is precipitate with rises to 105 or 106 F The temperature tends to fluctuate widely and irregular chilling is often encountered Nausea and vomiting are especially common in infants and adults with marked toxemia Less often the initial symptoms are referable to bladder irritation and include *dysuria urgency* and *frequency* Some type of *pain* is usually present. It may be localized to one or both lumbar regions and have a

dull aching quality Occasionally there are attacks of acute renal colic due either to acute ureteral obstruction from swelling and edema or to the movement of small calculi from the pelvis into the ureter The pain may also be referred to the upper or lower abdominal quadrants simulating that of acute abdominal disease *Tenderness* may be elicited in the costovertebral angle particularly if heavy percussion is employed using the ulnar surface of the palm or the clenched fist In some cases bimanual palpation reveals a tender and enlarged kidney

Diagnosis—The diagnosis of acute or recurrently acute pyelonephritis depends on a high index of suspicion on the part of the practitioner who deals with febrile episodes in young females infants and children, preg



Fig 564—Excretory urogram in a case of right sided pyelitis in pregnancy (fourth month) Cystogram is flattened from side to side left upper urinary tract approximately normal right (infected side) is slightly dilated Note ureteral kink which is common in pyelitis of pregnancy but in this instance may be an inspiratory kink *

nant women and old patients with urinary tract obstructions Frequent and repeated *urine examinations* are essential for the confirmation or refutation of the suspicion

The urine in acute pyelonephritis is usually scant and of high specific gravity There may or may not be a moderate albuminuria but microscopic examination reveals many *pus cells* per high power field unless the ureter is completely obstructed by swelling or exudate Variable numbers of red blood cells are found mingled with the leukocytes but casts are infrequently observed

The reaction of the urine varies with the type of invading organism

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An *acid urine* suggests an infection with B coli while an *alkaline reaction* is encountered in invasions due to streptococci staphylococci and B proteus

With high swinging temperatures and chilling there is often a *bacteremia* demonstrable by blood culture methods (p 53) The *hemogram* (p 3704) reveals a moderate leukocytosis but renal function is unimpaired unless there is an associated renal insufficiency or an obstructive uropathy

For Differential Diagnosis see *Pyuria* (p 2352) *Fever* (p 30) *Chills* (p 32) *Costovertebral Tenderness* (p 2274)

Course and Complications—Acute pyelonephritis usually runs a brief course of five to ten days duration After the temperature and physical signs have subsided the urine may contain pus cells and bacteria for several weeks

It is difficult to determine how much residual parenchymal damage occurs Certainly most patients seem to experience *complete healing* with little or no impairment of renal function at any time Others in all likelihood have persistent infection or frequent exacerbations as the result of which the secreting function of the kidney is impaired with serious and even ominous consequences It is quite possible that many of those afflicted with the *hypertensive toxemia of pregnancy* (p 2638) and the sufferers from *idiopathic renal insufficiency* initiated their ailments with a forgotten or insidious pyelitis Mindful of these aftermaths the wary practitioner is led by the continuation of a pyuria or the occurrence of exacerbations to insist upon a complete and careful urological survey including exploration by visual and roentgenographic technics In many instances *an anatomical obstruction or a concretion is demonstrable as a* predisposing cause or late complication of the pyelonephritic episode Elimination of the associated factor is then a potent prophylactic procedure against a later renal insufficiency or uremia (p 2275)

Treatment—The treatment of acute pyelonephritis has been greatly simplified since the advent of the anti infective agents The antibiotic streptomycin holds great promise in the treatment of urinary tract infections Given by intramuscular injection in doses of 250 000 to 500 000 units every four hours streptomycin exerts its greatest potency against *A aerogenes* coliform bacilli *B proteus Ps aeruginosa* and *B Friedlander* Streptomycin treatment may be combined effectually with the sulfonamides

Sulfanilamide—Sulfanilamide is effective against *B coli Aerobacter aerogenes Salmonella Shigella H influenzae Staphylococcus* and *Proteus vulgaris* It is ineffective against *beta hemolytic streptococci Streptococcus fecalis* and *enterococci* The treatment of most urinary infections requires urinary concentrations of sulfanilamide of 200 to 250 mg per cent for one week This may be obtained by a dose level of 5 gm daily with the fluid intake adjusted to approximate 1500 cc and maintain a urine output of 1000 cc daily In infections due to *B coli* the drug is more effective in an alkaline urine (pH 7 7) obtained by the daily administration of 2 to 5 gm of sodium bicarbonate

In most uncomplicated *acute bacillary infections* the urine becomes sterile within seven days As a rule mixed and coccal invasions are more resistant The criterion of cure is a sterile urine culture The drug is con

tinued until two sterile urine cultures have been obtained at four day intervals

Sulfathiazole—Sulfathiazole is as efficacious as sulfanilamide in the treatment of the common acute renal infections but is associated with the slight risk of precipitation of crystals in the urinary tract It is definitely superior to sulfanilamide against *Staphylococcus aureus* and *Streptococcus faecalis* A urine concentration of 200 mg per cent is sufficient for the cure of practically all common infections This level is obtained by the use of 4 gm daily and the maintenance of the urine output at about 1500 cc As in the case of sulfanilamide, treatment is continued until the urine becomes sterile The specimen is carefully observed with regard to volume degree of albuminuria and hematuria in order to detect the formation of sulfathiazole crystals which may cause obstructive anuria

Sulfadiazine and Sulfamerazine—Sulfadiazine and sulfamerazine give blanket coverage for most infections and are advised until the culture report is obtained Sulamyd in similar doses is equally effective

Other Urinary Antiseptics—Penicillin is a less effective urinary bactericide than sulfonamide or streptomycin Its use is limited to those who have had an unsuccessful trial of the other antibiotics and to patients who exhibit idiosyncrasy to sulfonamide Other urinary antiseptics such as mandelic acid hexamethylenamine hexylresorcinol and neoarsphenamine are of limited value

Bowel Hygiene—In addition to chemotherapy the patient is given *enemas* or *colon irrigations* to promote thorough evacuation of the bowel We are opposed to castor oil but favor the use of the gentler *salines* A bland spice free diet lessens urinary tract irritation

Urological Therapy—In severe infections occurring during pregnancy drainage of the affected renal pelvis may be required by means of an indwelling *ureteral catheter* Persistent infections and recurrences suggest the possibility of associated organic disease and require a meticulous survey by retrograde and intravenous visualizations

CHRONIC PYELONEPHRITIS

Chronic pyelonephritis is a common type of renal disease resulting from active infection and replacement fibrosis of the parenchyma

Pathology—In pyelonephritic infections associated with long standing chronic obstruction and hydronephrosis the kidney may be enlarged and the renal parenchyma reduced to a thin shell enclosing a collection of thick pus In other instances the kidneys are markedly contracted and atrophic the appearance suggesting a congenital renal hypoplasia In all types of chronic pyelonephritis the kidney is more or less adherent to the perirenal tissues and the renal pelvis and ureter are rigid and thickened The mucosa of the pelvis shows *retention cysts* and areas of *leukoplakia* *Renal calculi* of varying sizes and shapes are encountered

Microscopic study reveals evidences of acute inflammation interspersed with areas of *interstitial fibrosis* and *glomerular hyalinization* Often the walls of the renal arterioles are thickened (*endarteritis obliterans*) and evidences of an *acute arteriolitis* are noted as in the accelerated phases of an essential hypertension

Clinical Manifestations—*Continued pyuria* in a patient who has passed through an episode of acute pyelonephritis signifies the presence of a persistent infection In some patients the acute phase of the disease passes without recognition and the chronic stage is apparently idiopathic The

clinical picture is subject to considerable variation Local phenomena are deceptively few and the presenting symptoms are usually based on the generalized sepsis or the renal secretory breakdown

The obvious manifestations include recurrent attacks of *fever* and *chills* with malaise and anorexia lasting a few days or a week In the insidious variety the condition is not noted until a urine examination is made because of evidences of *advanced renal insufficiency* (p 2275) or *hypertensive cardiovascular disease* (p 900) The presence of the preexistent chronic



Fig 6 —Pyelo-ureterogram in advanced case of chronic suppurative pyelonephritis Terminal irregularities in pyelogram are strongly suggestive of tuberculous cavitation but examination of specimen disclosed only simple infection Note that true pelvis is not greatly distorted Ureter is irregularly dilated and in its pelvic segment shows filling defects due to thick pus Patient man aged 6 had had urinary infection since childhood Nephrectomy successful

pyelonephritis is first suggested by the finding of pyuria a renal calculus a congenital anomaly or prostatic hypertrophy

Diagnosis—The diagnosis of active chronic pyelonephritis requires a thorough urological study While pyuria is the rule variations in the urinary findings occur from day to day On one examination the urine may contain only a few scattered cells whereas the next specimen may be laden with pus *Urine cultures* are frequently positive and repeated examinations may reveal the causative organisms when one or two initial specimens are sterile The extent of the renal functional impairment can be estimated

tinued until two sterile urine cultures have been obtained at four-day intervals

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able improvement by facilitating the removal of pus and the free flow of urine

In *unilateral pyelonephritis or pyonephrosis a nephrectomy* must be considered especially if there is an associated hypertension (p 900) The antibiotics streptomycin and sulfonamides or penicillin must be given thorough trial as in the treatment of acute pyelonephritis (p 2353)

CORTICAL AND PERINEPHRIC SUPPURATION (MULTIPLE CORTICAL ABSCESSES RENAL CARBUNCLE AND PERINEPHRIC ABSCESSES)

Cortical and perinephric suppurations result from hematogenous staphylococcal or streptococcal infections The primary disturbance often is a pyoderma (p 3248) a paronychia or osteomyelitis Less often, the focus is in the teeth tonsils middle ear or nasal accessory sinuses Following a transient bacteriemia the organisms localize in one or both kidneys In contrast to pyelonephritis which is usually an ascending urogenous infection there are no local predisposing factors

Pathology—The pathological changes depend upon the severity of the bacteriemia and vary between a diffuse suppurative nephritis and localized "renal carbuncle" with or without perinephric extension

Diffuse Suppurative Nephritis—With a diffuse suppurative nephritis both kidneys are involved The renal surfaces are dotted with small abscesses and on cross section there are numerous similar lesions scattered throughout the cortex and to a lesser extent, in the medulla There may be an associated *septic thrombophlebitis* of the renal vein or its tributaries Microscopically numerous organisms are noted in the abscesses and in the glomeruli In the milder forms there is an *interstitial nephritis* with varying degrees of inflammation without suppuration Severer forms terminate in *fatal septicemia*

Renal Carbuncle—Multiple cortical abscesses or "renal carbuncles" follow a temporary and less severe bacteriemia One or a few abscesses are formed in one pole or in a discrete area of kidney These tend to coalesce and form a renal carbuncle which remains walled off from the calices and renal pelvis for a variable period of time Later the carbuncle may rupture into the collecting duct system setting up a *diffuse pyelonephritis* Abscesses located near the surface of the kidney produce a perinephritis and if they rupture result in the formation of a perinephric abscess

Perinephric Abscess—Perinephric abscesses are usually renal in origin but they may result from a direct infection of the perirenal tissue due to primary hematogenous invasion or an upward extension of infection from the prostate or fallopian tube The abscess remains well localized in many instances but usually tends to perforate in one direction or another The suppurative process may burrow posteriorly through a weak point in the lumbar musculature and appear beneath the skin of the lumbar region Occasionally penetration occurs through the diaphragm and into the pleural cavity or the lung Less often the abscess extends along and behind the psoas fascia and appears first in the inguinal regions the pelvis rectum bladder or uterus Anterior progression is most infrequent but may result in a diffuse peritonitis or a pericolonic or perigastric abscess

Clinical Manifestations—The initial manifestations of renal cortical and perinephric suppuration are wholly those of the bacteriemia resulting from the invasion of the blood stream Often the offending focus appears minimal and has completely healed by the time the systemic and distant phenomena have arisen The patient appears for a greater or lesser time to suffer from an "idiopathic" sepsis of greater or lesser severity There may be a low grade fever or a stormier pyrexia marked by chills and wide swings in temperature The hemogram reveals a leukocytosis and progressive anemia Blood culture reveals staphylococci or streptococci

The participation of the renal focus in the suppurative process may be

only by appropriate *urinary tests* (p 2240) and *blood chemical analyses* (p 3712)

Intravenous and retrograde urographic examinations are mandatory Dilatation of the upper third of the ureter is often seen as the result of inflammatory atony and obstruction of the lower ureter In the late stages the kidneys appear small the calices are deformed irregular or compressed and the ureters are alternately stenosed or dilated *Cystoscopy* supplements radiography by permitting examinations of the *ureteral specimens* to adjudicate the differential functions and involvements of the two sides

The *healed stage* of chronic pyelonephritis may be associated with extrarenal manifestations such as *hypertension impairment of renal function* or *uremia* At least 15 to 20 per cent of patients with *malignant hypertension* suffered a previous pyelonephritic involvement

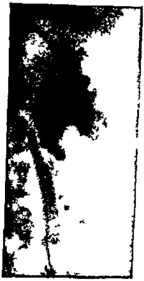


Fig 566—Ureteropyelogram showing dilatation with irregularities of calices due to stasis and infection (pyelonephritis) kinking of ureter at ureteropelvic junction apparent kinking due to pressure of catheter below this point and wide dilatation of ureter below the true kink There were adhesions at ureteropelvic junction kidney was infected but showed comparatively little loss of function Mobilization of kidney and nephropexy were done with good results *

For Differential Diagnosis see *Pyuria* (p 2352) *Fever* (p 30)

Treatment—The treatment of chronic pyelonephritis is highly individualized and is determined to a great extent by the clinical findings Patients with persistent nontuberculous urinary infection require a careful search for an *obstructive or calculous uropathy* (p 2264) and these impediments are eliminated if possible by appropriate surgical methods *Foci of infection* in the teeth tonsils nasal sinuses gallbladder and appendix are of lesser importance but warrant attention if more obvious etiologic phenomena cannot be demonstrated The use of *urinary antiseptics* is disappointing although a course of *sulfonamide* and/or *mandelic acid therapy* is attempted in any case and penicillin may prove to be highly useful

Pelvic lavage by means of a ureteral catheter may produce consider

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pneumonia With *posterior infiltration* spasm of the psoas muscle is noted and the production of a scoliosis (p 3059) with the concavity toward the involved side and inability to extend the hip

The protean manifestations of renal cortical and perinephric suppuration bewilder even the most experienced clinician Ordinarily it is not until after a lengthy period of careful observation that the diagnosis is first suspected and then established

For Differential Diagnosis see *Lumbar Pain* (p 2274) *Costovertebral Tenderness* (p 2274) *Fever* (p 30) *Chills* (p 32)

Treatment —Whether or not there is to be surgical intervention the patient is given systemic antibiotic therapy using sulfadiazine (p 88) and streptomycin (p 104) or penicillin (p 106) It is a grave mistake however to place too great reliance on chemotherapy alone The presence of definite areas of fluctuation or the aspiration of pus requires surgical intervention by an expert and experienced technician It is often a difficult decision to adjudicate the indicated procedure Diffuse suppuration requires a *nephrectomy* but naturally the kidney is spared if drainage by incision is deemed adequate Certainly the kidney should be *decapsulated aspirated* in suspicious areas and *incised* before being replaced Even then it may be necessary at a later time to complete the cure by means of a nephrectomy

revealed by physical or laboratory findings The patient may call attention to the region by a complaint of *lumbar pain* Palpation first reveals *costovertebral tenderness* and some *slight enlargement of the kidney* When perinephritis is more fully developed edema and swelling are noted in the loin and pus may be obtained by aspiration

The suggestive laboratory findings must be keenly sought Catheterized specimens after thorough centrifuging may reveal the organism in clumps or it may be revealed by culture methods A slight albuminuria a few pus and blood cells may be the only positive findings of a grave infection

Considerable assistance is often obtained by roentgenography The *scout plate* of the abdomen reveals obliteration of the shadow of the psoas muscle on the affected side Additionally there is demonstrable a

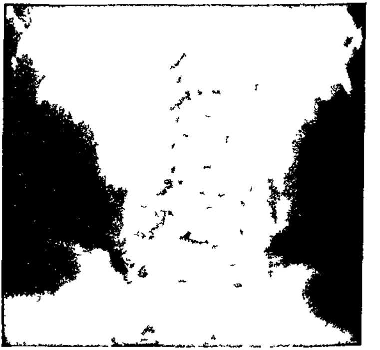


Fig 567—Perinephric abscess Note spinal curvature and absence of right psoas muscle

lumbar scoliosis with the concavity on the involved side due to psoas spasm and irritation The intravenous pyelogram shows a filling defect and compression of the calices or the pelvis of the affected side on the other hand it may be completely normal In contrast to radiographic evidence *cystoscopy* yields no positive information

Perinephric Abscess—With perirenal spread of infection the pain and tenderness may be misleadingly referred *Anterior progression* causes tenderness in the right or left upper quadrant and spasm of the rectus muscle on the affected side simulating an acute intra abdominal affliction *Postero inferior extensions* mimic the manifestations of an acute retrocecal appendicitis (p 1881) Abscesses of *the upper pole of the kidney* produce pain that suggests supradiaphragmatic involvements such as pleurisy or

* Alexander R Stevens and Frederick C McLellan in Pullen Medical Diagnosis

sinusitis subacute bacterial endocarditis osseous syphilis malaria Hodgkin s disease leukemia gout, rheumatic fever multiple myeloma and neoplasms undergoing degeneration Under these circumstances amyloid is deposited in the renal parenchyma and may result in a widespread disorganization of kidney function

Pathology —The essential renal lesion in amyloidosis is *glomerular* The deposition of amyloid leads to an obstruction of the glomerular capillaries and a progressive obliteration of the renal vascular bed The kidney is large and heavier than normal The capsule strips easily from the smooth pale, yellow surface which is often the color of old ivory The cortex is broad and sharply demarcated from the dark brown medulla The application of dilute acetic acid followed by Lugol s solution, produces a brown stain Crystal violet and other aniline dyes bring out a red color The staining reactions are fairly constant with relatively fresh amyloid but tend to disappear as the material ages

Histological study reveals amyloid deposits about the basement membranes of the glomerular capillaries The entire glomerular tuft may be converted into a homogenous mass of amyloid Deposits are found also in the walls of the afferent glomerular arterioles in the medium sized arteries and along the basement membranes of the tubules The amount of tubular damage depends on the degree of the glomerular obstruction

As the disease progresses the kidney becomes small hard and granular as a result of replacement of the functioning parenchyma by fibrous tissue whose growth is a reaction to the progressive renal ischemia At this stage *renal insufficiency* is present and *arterial hypertension* is not uncommon The gross appearance of the amyloid contracted kidney may be indistinguishable from the secondary contracted kidney of chronic glomerulonephritis (p 23 9)

On section, the *glomeruli* are fibrosed or converted into hyaline masses The *tubules* are collapsed, atrophic and separated by large areas of interstitial fibrosis There are occasional dilated and enlarged tubules lined with flattened epithelium The *vasa afferentia* and *renal arteries* show endarteritis obliterans and arteriosclerosis

In generalized amyloidosis deposits are found in almost every organ The *liver* and *spleen* are heavily infiltrated and the intestinal wall lymph nodes myocardium, thyroid gland adrenal glands trachea and larynx are also involved With the elimination of the underlying process responsible for the amyloid change, resorption of the deposits occurs

Clinical Manifestations —The clinical features of renal amyloidosis are usually obscured by the underlying disease whose manifestations dominate the clinical scene A mild *albuminuria* may be the only sign of kidney involvement Less often the renal element predominates and produces the manifestations of the *nephrotic syndrome* or a *renal insufficiency*

Nephrotic Syndrome—In renal amyloidosis the nephrotic syndrome presents its usual features of edema massive albuminuria hypoproteinemia lipemia and normal renal function The suspicion of amyloidosis is aroused by the appearance of the syndrome in a patient with chronic disease and progressive hepatomegaly and splenomegaly A positive diagnosis is afforded by the Congo Red test (p 7) in which there is a rapid disappearance of the dye from the blood

Renal Insufficiency—Renal insufficiency develops in patients with amyloid contracted kidneys Nontuberculous patients develop a marked hypertension with cardiac hypertrophy and retinal arterial changes In the tuberculous the blood pressure is usually low and retinal lesions are absent As in the nephrotic stage in the Congo Red test the dye disappears rapidly from the blood

Differential Diagnosis —See *Edema* (p 717) *Hypertension* (p 910) *Albuminuria* (p 2370)

Treatment —There is no recognized specific method of treating amyl

CHAPTER 112

THE URINARY SYSTEM NEPHROPATHIES

THE nephropathies are the clinical disturbances other than frank infection and suppuration which involve the secreting mechanism of the kidneys They are ordinarily regarded as the medical aspects of urology, an attitude which we have attempted to avoid The renal cortex suffers functionally if not morphologically with each uropathy whether it be merely a mechanical disturbance an infection or a neoplasm The approach to the relief of a nephropathy is often best initiated by a *urological investigation* which may lead to the elimination of a provocative factor such as urinary obstruction stasis chronic infection urolithiasis or a neoplasm

PARENCHYMATOUS DEGENERATION (CLOUDY SWELLING) OF THE KIDNEYS

Cloudy swelling of the kidney occurs in almost every febrile episode The condition is recognized clinically by the presence of a varying degree of *albuminuria* with *cylindroids casts* and an occasional leukocyte or erythrocyte in the urinary sediment Renal function is not impaired and the abnormal urinary findings disappear with the subsidence of the fever

This type of febrile nephrosis is the commonest type of nephropathy It has no ominous connotation since the disturbance is reversible and recovery is the rule It must not be confused with the more important nephropathies later described else the patient dwell in constant fear of a nonexistent pathologic affliction For Differential Diagnosis see *Albuminuria* (p 2370)

Cloudy swelling of the kidney requires no particular therapy other than the administration of large amounts of fluid at least sufficient to maintain the daily output at 1500 cc

RENAL AMYLOIDOSIS

The deposition of amyloid a complex protein discussed elsewhere at greater length (p 7) occurs in *chronic diseases* such as tuberculosis pyogenic infections bronchiectasis lung abscess osteomyelitis purulent

Tubular Nephrosis	Hyperparathyroidism Hemoglobinuria Precipitation of sulfonamide crystals Multiple myeloma	Marked	Few	Rare	Rare	High	Low	Impaired	Azotemia
Tubular Nephritis	Mercury poisoning Alkalosis	Marked	Few	Rare	Rare	High	Low	Impaired	Azotemia
Acute Glomerulonephritis	Upper respiratory infection especially streptococcal	Marked	Many	Rare	Many	High	Low	Impaired	Azotemia
Chronic Glomerulonephritis	Previous acute attacks	Slight	Few	Rare	Rare	Low	High	Impaired	Azotemia
Lipoid Nephrosis	Previous chronic glomerulonephritis Amyloidosis Diabetes mellitus	Marked	Few	Rare	Rare	High	Low	Impaired	Hypoproteinemia Hypercholesterinemia

DIFFERENTIAL DIAGNOSIS OF

Nephropathies

Type	Attendant Circumstances	Albumin	Casts	W B C	R B C	Spec Grav	Volume	Renal Function	Blood Chemistry
Parenchymatous	Fever	Moderate	Many	Rare	Rare	High	Low	Normal	Normal
Amyloid	Prolonged suppuration	Moderate	Few	Rare	Rare	Low	High	Impaired	Azotemia
Focal Interstitial	Acute infection *especially* respiratory	*Moderate*	*Few*	*Rare*	Moderate	High	Normal	Normal	Normal
Diffuse Acute Glomerulitis	Subacute bacterial endocarditis	Moderate	Few	Rare	Moderate	High	Normal	Impaired	Azotemia
Chronic Passive Congestion	Backward failure	Marked	Few	Rare	Rare	High	Low	Impaired	Normal
Diffuse Vascular Disease	Arteriosclerosis Diabetes mellitus Periarteritis *nodosa* Diffuse lupus erythematosus	Moderate	Few	Rare	Rare	Low	High	Impaired	Azotemia

therapy is indicated for prophylactic effect if for no other reason If the fundamental disturbance is apt to be recurrent as in a tonsillitis surgical removal of the focus is highly advisable

DIFFUSE ACUTE GLOMERULITIS

Renal lesions are constant findings in *subacute bacterial endocarditis* (p 1021) due to the *Streptococcus viridans* Occasionally they are observed also in protracted valvular infections due to the *gonococcus* the *pneumo*



Fig 6 —Acute and subacute nephritis showing punctiform hemorrhages and opaque yellow flecks which are produced by the degenerated epithelium

coccus or the *influenza bacillus* In only a few of these patients is the renal damage sufficiently extensive to produce impairment of function

Pathology —The kidneys of a subacute bacterial endocarditis are normal in size or slightly swollen but their surfaces are often covered with multiple pinpoint hemorrhages giving the characteristic flea bitten appearance Microscopically this appears to be caused by

MacCallum Textbook of Pathology

oidosis The fundamental disturbance is attacked and if a 'cure can be effected amyloid deposits disappear since amyloidosis is a reversible process

It is said that injections of *liver extract* (p 1081) favor the regression of amyloid deposits and certainly they can do no harm The manifestations of the nephrotic syndrome and renal insufficiency are treated symptomatically (p 2385)

FOCAL INTERSTITIAL NEPHRITIS

The production of a focal nephritis during the course of an acute infection is announced by the appearance in the urine of large amounts of *albumin casts* and an appreciable number of *red blood cells*

Etiology—Focal nephritis is a manifestation of an *active infection* and in contrast to an acute glomerulonephritis occurs at its height The lesions are produced by the direct action of bacteria on the renal parenchyma The causative organisms are usually demonstrable in the urine during life and in the kidney at autopsy

Streptococcal infections are the common precursors of a focal nephritis which frequently occurs in the course of an acute tonsillitis or an erysipelas The lesions are seen also in *typhoid fever* when they are associated with a typhoid bacilluria Similar manifestations are encountered in *malaria relapsing fever rat-bite fever Weil s disease* and *yellow fever*

Pathology—The most striking change in the gross appearance of the kidney is the presence of varying numbers of small *surface hemorrhages* Microscopically most of the glomeruli are normal but some contain masses of exudate and areas of hemorrhage within the capsular spaces In some of the capillary tufts the endothelium is swollen and proliferated Scattered areas of interstitial hemorrhage and leukocytic infiltration are usually present and from these bacteria may be cultured

Clinical Manifestations—In most instances focal nephritis is *asymptomatic* The only indication of its presence is the demonstration of a *hematuria* a moderate *albuminuria* and the presence in the microscopic sediment of the urine of a number of *hyaline granular and cellular casts* Renal function is grossly unimpaired

In *typhoid fever* (p 225) the focal nephritis is often present at the onset *Yellow fever* (p 477) is marked by a considerable degree of renal involvement the urine is usually scant loaded with albumin and casts and death is often associated with anuria and uremia In nonfatal instances a restoration of renal function heralds a favorable prognosis Similar but milder renal manifestations are seen in streptococcal infection in Weil s disease and in relapsing fever

Diagnosis—It is important to differentiate focal nephritis from *acute glomerulonephritis* (p 2373) The significant differential points relate to the timing of the complication *Focal nephritis* occurs at the height of the infection its course is self limited and recovery is the rule By contrast, *acute glomerulonephritis* (p 2373) occurs during convalescence it may be accompanied by diminution of renal function and followed by chronic disturbances terminating in uremia or marked cardiovascular manifestations

Differential Diagnosis—See *Hematuria* (p 2306) *Albuminuria* (p 2370)

Treatment—In the presence of a focal nephritis intensive penicillin

in the renal parenchyma but in only a minority of instances is the involvement sufficiently great to produce significant impairment of renal function

Renal Pathology —Grossly the kidneys of essential hypertension appear normal or slightly enlarged At first the surface is smooth but in more advanced examples the kidneys are contracted and indistinguishable in appearance from those of *chronic glomerulonephritis* (p 2379) The capsule is adherent and difficult to remove The surface is marked by coarse and fine granulations The cortex is thin and the large arteries have visibly thickened walls

In the *accelerated* or *malignant phase* of essential hypertension (p 908) the kidneys are usually swollen and numerous yellowish areas and hemorrhages are visible on the surface Microscopy reveals areas of parenchymal atrophy separated by large sections of intact renal cortex The glomeruli in the atrophic areas are diffusely hyalinized the capsule is thickened and fibrosed the associated tubule atrophies and the entire nephron becomes replaced by scar tissue In the intact areas the tubules hypertrophy and are often greatly dilated

The essential *vascular lesion* is a hyaline degeneration and thickening of the intima of the vasa afferentia The disturbance narrows and finally obliterates the lumen of the vessel In the larger interlobular arterioles the internal elastic membrane of the intima undergoes hyperplasia and reduplication Subsequently there is degeneration of the intima into a mass of collagenous connective tissue narrowing the lumen The *medial muscle layer* undergoes gradual atrophy and fibrous replacement so that vascular tonus and flexibility suffer

In the accelerated phase there are additional changes in the afferent and interlobular arterioles which undergo necrosis and endarteritis *Thrombosis* is frequent and the pathological changes progress to involve the smaller renal arteries and arterioles

Pathological Physiology —See *Renal Ischemia* (p 2273)

Clinical Manifestations —In most patients with essential hypertension the renal changes are minimal At most there is a moderate degree of *albuminuria* with *hyaline or granular casts* in the urinary sediment In the *accelerated phase* the albuminuria is more marked and red cells appear in the microscopic examination

Renal function is rarely impaired even when there are marked pathological changes although a fatal uremia may be precipitated by cardiac failure acute infection or a severe anemia Under these circumstances there are the usual phenomena of renal insufficiency (p 2275)

In the accelerated phases of the disease there may be rapid onset of *renal failure* or even an *acute uremia* (p 2276) More often however the clinical syndrome is featured by the *hypertensive phenomena* and their *sequels* (p 2384)

Differential Diagnosis —See *Hypertension* (p 910)

Treatment —The treatment of the renal element in essential hypertension is wholly symptomatic Efforts are made to eliminate foci of infection maintain cardiac function and prevent anemia The therapeutic endeavors aimed at the control of the vascular status are elsewhere described (p 911)

an acute glomerulitis characterized by the proliferation of intracapillary endothelial cells This diffuse process is analogous to that seen in *acute glomerulonephritis* and is of either toxic or allergic origin Other glomeruli reveal thickening of the basement membrane of the tufts or focal lesions in the nature of a proliferation of the capsular endothelium There may also be fibrous lesions complete glomerular disorganization and hyaline fibrinoid thrombi or masses of bacteria in the glomerular vessels The focal manifestations usually occur in those glomeruli which also show the diffuse lesions and are regarded as the results of minute bacterial emboli

Clinical Manifestations—The presence of an acute glomerulitis occurring in the course of a subacute bacterial endocarditis is revealed only by the finding of a *hematuria* which is usually moderate but may be severe enough to be grossly recognized *Albuminuria* is slight or moderate and as a rule there are present but a few *casts* *Renal function* rarely is impaired but occasionally the glomerular lesions are sufficiently extensive to produce *uremia*

Differential Diagnosis—See *Hematuria* (p 2306) *Albuminuria* (p 2370)

Treatment—As in focal nephritis intensive penicillin therapy is indicated for the prevention of further renal damage if for no more specific indication

CIRCULATORY DISTURBANCES OF THE KIDNEY

Systemic and local disturbances of renal circulation are reflected by functional abnormalities of the renal parenchyma The effects of *renal ischemia* (p 2273) *thrombosis and embolism of the renal artery* (p 2329) *phlebitis involving the renal veins* (p 2330) and the mechanical disturbances due to kinking of the renal pedicle producing *orthostatic albuminuria* (p 2294) have been described elsewhere The present concern is the effect of passive congestion of the kidneys

Chronic Passive Congestion of the Kidneys—Interference with the outflow of venous blood from the kidney results from cardiac failure or local pressure from intra abdominal neoplasms aneurysms or thrombosis of the renal veins Each of these conditions causes marked congestion manifested by *albuminuria* *cylindruria* and *hematuria* Renal function is affected only to a slight degree in most of these disorders but with cardiac failure the anoxemia may precipitate a severe degree of *renal insufficiency* (p 2275) Restoration of compensation then produces a dramatic improvement in renal function

Differential Diagnosis—See *Albuminuria* (p 2370), *Hematuria* (p 2306)

DIFFUSE VASCULAR DISEASE OF THE KIDNEY

The kidney is affected by a variety of diffuse vascular disorders of unknown etiology In many respects these disturbances are similar to *acute glomerulonephritis* (p 2373) which in essence is also an affection of the renal blood vessels The important differentiation is based on the fact that in the latter condition the clinical emphasis relates to urinary findings and renal function By contrast the diffuse vascular disorders of the kidney are overshadowed by extrarenal difficulties

ESSENTIAL HYPERTENSION

The renal arterioles are involved in the *general arteriosclerosis* of essential hypertension (p 900) Multiple areas of atrophy are revealed

RENAL	
Nephropathies	[illegible] deposits with casts and good function (p. [illegible]) Amyloidosis with hypoalbuminemia, hepatosplenomegaly and positive Congo red reaction (p. 71) Focal embolic deposits with casts and normal renal function (p. [illegible]) Diffuse acute glomerulitis, particularly associated with deposition of sulfonamide crystals (p. [illegible]) Diffuse vascular diseases such as generalized arteriosclerosis, hypertension, periarteritis nodosa with eosinophilia, and acute diffuse lupus erythematosus with eruption (p. 2372). Acute glomerulonephritis with hematuria, oliguria, high specific gravity and relatively normal renal function (p. [illegible]) Chronic glomerulonephritis with [illegible] casts, increased volume decreased specific gravity and azotemia (p. 237[illegible]) Nephrotic phases with decreased volume increased specific gravity marked edema, hypoproteinemia and hypercholesterolemia (p. 22[illegible])
Poisonings	Irritation due to mercury, phosphorus, arsenic, [illegible], lead, bismuth, turpentine, carbon tetrachloride, sulfonamides, phenol, [illegible], ether or chloroform.
Toxemias	Hypertensive toxemia of pregnancy (p. [illegible]) or bilateral cortical necrosis (p. 2330) Note elevation of blood pressure, edema and convulsions. Cholemia with jaundice or disturbances of liver function (p. 15[illegible])
Generalized Infections	Febrile disorders, particularly bacteremias, infectious hepatitis, yellow fever, malaria and subacute bacterial endocarditis. Order blood cultures (p. 50) Wassermann test, icterus index (p. 1947) and examine spreads for plasmodia (p. 507)
POST RENAL	
Uropathies	Infections involving urinary tract and producing obstruction, hematuria, hemoglobinuria or pyuria (p. 2352) Refer to urologist for urography, cystoscopy and catheterization of ureters. Examine differential specimens by smear, culture and carbolfuchsin stain for acid fast bacilli (p. 49) Inject into guinea pigs (p. 63) Get biopsy where indicated. Consider exploratory operation.

PERIARTERITIS NODOSA

Renal damage is a constant and sometimes prominent feature of periarteritis nodosa The renal vessels show the characteristic changes of the disease which consist of a necrosis of the media infiltration of the vessel walls with eosinophils and plasma cells multiple areas of thrombosis and rupture of the involved vessels The kidneys appear small with an irregular granulation of the surface The glomeruli and tubules supplied by the involved vessels are atrophic and interstitial areas of hemorrhage are scattered throughout

DIFFERENTIAL DIAGNOSIS OF

Albuminuria

Small quantities of albumin, not detected by routine laboratory methods are found in normal urine An increase in urinary albumin beyond 28 to 78 mg per liter constitutes a pathologic finding whose significance requires careful evaluation

The proteins of the urine are chiefly albumin and globulin derived from circulating blood. The ratio of albumin to globulin is as 10 1 In most instances of renal disease predominance of albumin is due to the smaller size of the molecule which easily traverses glomerular endothelium when permeability is impaired. At times other proteins gain entrance to the urine as in hemoglobinuria and Bence Jones proteosuria

Like azotemia albuminuria may be renal prerenal or post renal Post renal albuminuria is due to the presence of infection and invariably is associated with pyuria (p 2352) Renal albuminuria is found in the nephropathies Prerenal albuminuria accompanies systemic conditions in which there is neither renal damage nor infection

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

PRERENAL

Physiologic	In the neonatal period After a protein rich meal. Following a cold bath or exposure to intense atmospheric cold Following violent physical exertion
Orthostatic	Albuminuria when patient assumes erect position. Usually in individuals of ptotic habitus. Often associated with nephroptosis Unassociated with changes in renal function.
Circulatory	Forward failure associated with shock from whatever cause Backward failure Pressure on renal veins due to massive ascites intra-abdominal tumors or huge spleen. Thrombosis of inferior vena cava
Hemic	Severe anemia resulting in glomerular anoxemia and increased permeability of the kidneys Obtain hemograms (p 3704) and consider transfusion. Accompanying hemoglobinemias and hemoglobinurias
Neurogenic	Following convulsions from whatever cause No alteration in renal function.
Metabolic.	Obstructive jaundice and conditions associated with cholemia. Note icterus and impairment of test of hepatic function (p 1947) Hyperparathyroidism with diffuse cystic disease of bone Thyrotoxicosis with elevation of B M R. Diabetes mellitus with nephrotic syndrome Gout with tophi podagra and hyperuricemia. Vitamin C deficiency with scurvy and therapeutic response to cevitamic acid.

CONTINUED

drugs (p 96) is however of sufficiently frequent occurrence and intensity to warrant a constant alert on the part of the careful practitioner

Clinical Manifestations and Treatment—The recognition of tubular nephrosis is possible only through careful and repeated studies of the urinary sediment The first appearance of *red cells* or *crystals* establishes the diagnosis and active therapy should be initiated If the nephrosis is due to precipitation in the urine from a drug and if the patient s condition warrants administration of the drug is discontinued If chemotherapy cannot be interrupted however the *fluid intake is increased* in order to dilute the urine Alkalies are given in the proportion of 2 to 3 gm of bicarbonate of soda to 1 gm of sulfonamide since precipitation is less apt to occur in a dilute alkaline urine

In more malignant or unrecognized examples of tubular nephrosis the initial manifestation is *gross hematuria oliguria* or *anuria* With the last two the concentration of the blood metabolites rises renal function becomes progressively impaired and the features of uremia are encountered The sequence of events is the same whether the renal complication occurs in *hyperparathyroidism* (p 1232) *multiple myeloma* (p 1126) the *hemoglobinurias* (p 1073) or the *crush syndrome* (p 2372) Very probably the urate deposits which are seen in *gout* (p 2367) and which lead to the formation of calculi represent a similar mechanism and account for the urinary findings in this condition

Differential Diagnosis.—See *Hematuria* (p 2306) *Anuria* (p 2232)

The severe obstructive nephropathies may be relieved by expert *ureteral lavage* (p 2254) Meantime fluids are administered parenterally unless the manifestations of water intoxication (p 705) are observed

TUBULAR NEPHRITIS

It is doubtful whether true inflammation of the urinary tubules ever exists as a separate clinical entity In the majority of instances the involvement is part of the more generalized condition of *acute glomerulonephritis* (p 2373) Often the disturbance is the *tubular nephrosis* which has just been described Only in *mercury poisoning* (p 765) and *alkalosis* are the inflammatory changes in the tubules sufficient to warrant the concept of a tubular nephritis See *Mercury Poisoning* (p 765)

Alkalosis—The chronic alkalosis that occurs in patients with peptic ulcer (p 1780) from the overzealous use of sodium bicarbonate and in pyloric obstruction (p 1789) is capable of producing renal complications The *tubules* are extensively damaged and there are numerous areas of *calcification* Renal function is impaired and the nitrogenous constituents of the blood are increased The concentrating power of the urine is limited and the individual specimens contain albumin and casts

The renal disturbance is alleviated by using *nonsystemic antacids* (p 1754) in the treatment of the ulcer symptoms and by securing operative relief for the *pyloric obstruction*

ACUTE GLOMERULONEPHRITIS

Acute glomerulonephritis an acute inflammatory disease of the kidneys is the renal component of an extensive injury to the entire capillary sys

Clinically, the renal complication of periarteritis nodosa is heralded by the development of a *moderate albuminuria* and a microscopic *hematuria*. Occasionally an involved vessel ruptures into the perirenal regions producing an *acute hematoma* *Treatment* is ineffective (p 1027)

ACUTE LUPUS ERYTHEMATOSUS DISSEMINATUS (ATYPICAL VERRUCOUS ENDOCARDITIS LIBMAN SACKS DISEASE)

Involvement of the renal blood vessels is a constant feature of the widespread disease of the capillaries and other endothelial structures that is featured clinically by the eruption which gives to the syndrome the name of acute lupus erythematosus disseminatus (p 3399) The minute renal vessels show endothelial swelling proliferation and necrosis There is often a characteristic wire loop appearance of some of the glomerular capillaries

The clinical findings are limited to the presence of *hematuria* and *albuminuria* Renal function is usually well maintained but uremia is described in an occasional patient *Treatment* is wholly unsatisfactory (p 3401)

DIABETIC GLOMERULOSCLEROSIS

Renal complications are frequently seen in patients with *diabetes mellitus* (p 1246) A small number of patients show a fairly unique renal vascular lesion of unknown causation The distinctive renal pathologic finding consists of hyaline thickening of the intercapillary connective tissue from which circumstance the condition has been termed an *intercapillary glomerulosclerosis*

The clinical suspicion of renal involvement in the diabetic is aroused by the appearance of moderate *albuminuria* associated with varying degrees of *edema* Often there are marked *retinal lesions* consisting of white deposits hemorrhages and exudates

The clinical problem involves control of the diabetes and the elimination of infectious complications At best the residual renal tissue can be protected

TUBULAR NEPHROSIS

The precipitation of renal excretory products in the lumen of the tubules occasionally results in mechanical occlusion of these excretory ducts and injury to the lining endothelium Thus in *hyperparathyroidism* (p 1232) the excessive excretion of calcium gives rise to a nephrocalcinosis and the formation of renal calculi The contracted kidney observed in *multiple myeloma* (p 1126), is probably due to tubular obstruction resulting from casts of the Bence Jones proteose and the increased urinary excretion of calcium that usually coexists In massive hemolysis such as occurs in *hemoglobinuria* (p 1073), free hemoglobin precipitates in the lumen of the renal tubules in sufficient degree to cause obstructive anuria The crush syndrome of civilian and combat experience, is most likely an acute tubular obstruction caused by pigment casts derived from myohemoglobin

From the clinical viewpoint tubular nephrosis derived from the above etiologic factors is encountered infrequently and is of minor importance. The precipitation of the urinary excretory products of the *sulfonamide*

The sequence of events suggests that the nephritis develops as a manifestation of *hypersensitivity* since it occurs during the process of immunization in a manner analogous to the production of serum sickness (p 518) This hypothesis has received experimental support from studies which demonstrate that the nephritic kidney is hypersensitive to the nucleoprotein of the hemolytic streptococcus and that the lesions of nephritis can be produced in experimental animals by immunological methods

In addition to infection there are other important factors predisposing to acute glomerulonephritis Exposure to *cold and dampness* are important precipitating factors It has been suggested that the chilling of the periphery of the body produces a reflex vasoconstriction and ischemia of the kidneys which in some ways set off the disease process There is a definite age factor the incidence being *greatest in childhood and early adult life* and lowest in early infancy and old age *The existence of a constitutional basis is suggested by the relative* rarity of nephritis despite the great frequency of provocative infections

Pathology—The *principal lesions* of acute glomerulonephritis are found in the kidneys both of which are similarly involved On gross examination they are slightly enlarged and rather soft The capsules strip easily from the smooth grayish brown surfaces which are dotted with *punctate hemorrhages* On cross section the cortex appears pale while the medulla is dark and congested

Microscopically the primary and predominant lesion is in the capillary loops of the glomeruli These are at first dilated ischemic and filled with coagulated material The endothelial cells are swollen and proliferated so that each capillary is lined by several layers of cells Large numbers of leukocytes and erythrocytes accumulate within the glomeruli The entire glomerulus is transformed into a large nuclear mass which completely fills the capsular space The individual endothelial walls fuse into a syncytial network and become hyalinized In contrast to the glomerular changes the tubules appear unchanged except for slight evidence of cloudy swelling and fatty degeneration Large numbers of erythrocytes and leukocytes and masses of coagulable material are found in the tubular lumen In some instances a necrotizing arteriolitis of the afferent vessel and thrombotic occlusion are present

The process of healing starts with the removal of the exudate blocking the glomerular capillaries Regeneration may be so complete as to leave no vestige In less fortunate circumstances many of the glomeruli become fibrotic and hyalinized and the patient progresses to the stage of a *chronic nephritis*

Extrarenal Lesions—Although the kidney bears the brunt of the vascular damage other tissues are also affected Intravitam capillary microscopy has revealed an increased tortuosity of the *nail bed capillaries* with spastic contraction of the arterial limb and distention of the venous limb *Petechiae* sometimes are present on the skin and mucous membranes Analysis of edema fluid reveals a high protein content pathognomonic of an *increase in capillary permeability* The *heart* is usually enlarged due to an acute dilatation of the left ventricle Occasionally an appreciable degree of *left ventricular hypertrophy* is present and there may be a *pericardial effusion*

Few changes are observed in the central nervous system even in those patients who have suffered convulsive seizures just before death The brain often is swollen and edematous and in patients who have had increased intracranial pressure the convolutions are flattened the ventricles are dilated and the medulla is compressed

Clinical Manifestations—The typical example of acute nephritis occurs in children One or two weeks after the subsidence of an attack of acute tonsillitis the child becomes weak listless and fretful the mother notices puffiness of the child's face and a dark reddish brown color to the urine As the disease develops headache is severe and there may be recurrent episodes of nausea and vomiting The youngster has a characteristic pasty pallor edema a rapid and overactive heart and hypertension The urine appears smoky or bloody and contains albumin casts and red blood cells

The clinical picture varies with regard to mode of onset and severity of the symptoms and signs In many instances the disease escapes recognition unless it is detected by routine urinalysis In others the course is

tem The onset usually follows a subsiding *acute upper respiratory infection* Although most patients recover without sequel 5 per cent die in the acute attack and perhaps 25 per cent develop chronic disability

Etiology —The development of acute glomerulonephritis has been observed after a great variety of infections although the most common causative organism is the *hemolytic streptococcus* The disorder is most frequently encountered after *acute tonsillitis scarlet fever erysipelas* and *burns* or *wounds* infected with streptococci Occasionally it is seen as a complication of *pneumococcal lobar pneumonia* the *pyodermas typhoid fever typhus fever malaria measles chickenpox smallpox* and *mumps* It is not uncommon in the bacteria free stage of *subacute bacterial endocarditis* and in *gonococcal endocarditis* Despite the close re-



Fig 569 —Acute nephritis Hyaline fibrinous thrombi in glomerular capillaries *

lation of *acute rheumatic fever* to hemolytic streptococcal infections nephritis is seen only rarely in association with this disease In those patients in whom there is no obvious infection preceding the nephritis it is likely that a *subclinical streptococcal infection* occurred

Pathogenesis —Although the manner in which distant infection gives rise to the acute nephritic process is not wholly understood a number of interesting facts have been established The disease is seen rarely during the height of an acute infection and is not caused by the presence of bacteria in the involved tissues The typical syndrome initiates after the acute infection has passed and when the patient is well into convalescence Thus in patients with tonsillitis the nephritic picture appears one or two weeks after the acute angina has subsided in postscarlatinal nephritis the urinary findings are noted at the time that desquamation is occurring or when it already has taken place

* MacCallum Textbook of Pathology

glomerular blood flow due to the vasoconstriction and blocking of the capillary lumens by exudate a *prerenal deviation of fluid* in the process of edema formation and a moderate degree of *fluid loss* from vomiting It is also likely that the oliguria may be a manifestation of an *increase in tubular reabsorption* as a result of tubular injury such as occurs in mercurial anuria (p 766)

The *specific gravity* of the urine is frequently high but severe involvements are associated with an ominous *hyposthenuria* (p 2231)

Hematuria is always present The amount of blood varies from a brisk renal hemorrhage producing a grossly bloody or smoky urine to a degree of bleeding detectable only by microscopic examination Marked hematuria gradually subsides but microscopic hematuria persists for a long time

A moderate degree of *albuminuria* is a constant finding as is to be expected in any renal disease in which there is extensive capillary damage The degree of albuminuria is almost never as severe as in the nephrotic syndrome During convalescence the albuminuria may become orthostatic in type As in the case of hematuria it persists for long periods after the other features of the disease have completely cleared

Microscopic examination of the urine reveals many *erythrocytes leukocytes* and *casts* The latter are predominantly *hyaline* but may be impregnated with red blood corpuscles forming *blood casts* The extent of renal functional impairment is usually mild or moderate The findings include a decreased excretion of phenolsulfonphthalein impairment of maximum concentrating power and lowered urea clearance As the disease subsides the impairment of concentrating power is usually the last functional defect to clear

Blood Findings —The blood chemical changes are characteristic of *renal failure* (p 2275) There is a slight elevation of the *nonprotein nitrogen* but when anuria is present extremely high values are encountered The increase in nonprotein nitrogen is paralleled by an increase in *uric acid creatinine* and *urea* There are no consistent changes in blood cholesterol sodium potassium or chloride and the serum protein concentration is normal There are usually a slight or moderate polymorphonuclear *leukocytosis* and a slight *anemia*

Differential Diagnosis.—See *Edema* (p 717) *Headache* (p 1510) *Convulsions* (p 1519) *Albuminuria* (p 2370) *Hematuria* (p 2306) *Hypertension* (p 910)

Prognosis —Most patients recover completely the signs and symptoms reach maximum intensity within a few days after the onset and then regress rapidly Within two or three weeks the only residua are mild hematuria and albuminuria but it may take months or even years before the urine is entirely normal

In general the ultimate prognosis is better in children than in adults In the former well over 90 per cent recover completely in the latter the recovery rate is a little better than 50 per cent If the patient survives the acute episode however he may eventually become a chronic nephritic

The prognosis is not determined by the *intensity of the disease* since cases following a mild and insidious course may progress to the stage of chronicity Conversely a fulminating disease with cardiac failure and convulsions may heal completely The prognosis is better following a severe

dominated by *recurrent paroxysmal dyspnea* or *epileptiform convulsions* that terminate fatally within a few days

Edema—Edema is absent only in the mildest inflammations It is usually preceded by gain in weight and oliguria and it may come on slowly or suddenly The lax subcutaneous tissues about the *eyes* are affected first As the edema increases, it appears on the *ankles fingers* in the *scrotum vulva* over the *anterior tibial regions* and *sacrum* Occasionally there is a massive *pleural or pericardial effusion* or a large amount of *ascites* (p 19?1) In rare instances there may be an *acute edema of the larynx* (p 2101) The edema is due to a general increase in capillary permeability as indicated by the high protein content of the edema fluid

Cardiovascular Disturbances—A moderate degree of *arterial hypertension* is usually present from the onset although it may not be detected until after the appearance of edema and hematuria Extreme hypertension is attended by *epistaxis headache stiff neck* and the syndrome of *hypertensive encephalopathy* (p 2376) The cause of the arteriolar spasm responsible for nephritic hypertension is not known In view of the role of *renal ischemia* in the pathogenesis of other types of renal hypertension it seems most likely that it is a reaction to an impaired renal blood flow (p 2273)

The *heart* is enlarged as a result of an acute dilatation Mild degrees of myocardial insufficiency are frequent and are manifest by palpitation dyspnea and tachycardia On rare occasions severe cardiac failure is present almost from the onset The existence of myocardial damage in acute nephritis is indicated by the frequency of abnormal electrocardiographic findings

Neurological Phenomena (Hypertensive Encephalopathy)—Acute cerebral episodes termed hypertensive encephalopathy are fairly common in children but less frequent in adults with acute nephritis The attacks may occur at the onset of the disease or after it has begun to subside In a *mild form* the attack consists of transitory aphasia weakness of one half of the body visual impairment or a severe headache attended by a stiff neck Typically the *severe attack* is featured by a generalized epileptiform seizure preceded by a prodromal period of nausea vomiting headache somnolence and rising blood pressure The convulsion is first tonic and then clonic Consciousness is lost during the attack which may last a few seconds or several minutes and the seizures may recur with great rapidity producing a status epilepticus Repeated seizures are dangerous and may terminate fatally or precipitate a sudden heart failure

The cerebral symptoms are ascribed to *cerebral ischemia* caused by an acute spasm of the cerebral arterioles Lumbar puncture reveals increased cerebrospinal fluid pressure and the brain appears swollen and edematous

Urinary Abnormalities—Urinary abnormalities are invariably present and reflect the pathological alterations taking place in the glomerular capillaries The *urine volume* is diminished particularly at the onset There may be total *anuria* although usually during the height of the disease the daily urine volume varies between 400 and 800 cc One of the earliest signs of improvement is a brisk diuresis

The cause of the oliguria is not definitely known It seems likely however, that the several factors leading to its production include *decrease in*

a generation of study to determine more accurately the prophylactic value of this measure but there can be no doubt from preliminary observations that future clinicians will see much less acute glomerulonephritis This prospect must not however lull the practitioner into a false sense of security since acute glomerulonephritis has already been observed in a fair number of patients with streptococcal infections adequately treated by sulfonamides

Sedation—The appearance of hypertensive encephalopathy poses a difficult problem for the practitioner We favor heavy sedation at the onset of symptoms with large doses of *chloral hydrate* (p 3836) or *paraldehyde* (p 3845) *Morphine* in our opinion should be reserved for the amelioration of symptoms resistant to therapy with the less noxious drugs Efforts should be made to decrease intracranial pressure by the performance of a *lumbar puncture* (p 3781) by *venesection* (p 3780) by the intravenous injections of 50 to 200 cc of hypertonic sugar solutions (*dextrose sucrose*) or the soluble *barbiturates* such as sodium phenobarbital or sodium pentothal (p 3773)

Magnesium sulfate (p 613) is employed by many clinicians for the prevention and control of convulsions The injections are administered *very slowly* and the pharmacological antidote of a *soluble calcium salt* (p 604) is to be readily at hand When there are active convulsions 10 to 20 cc of a 10 per cent solution are given intravenously or 15 cc of a 20 per cent solution are injected into the gluteal muscles using a preliminary instillation of a small amount of 1 per cent procaine as a local anesthetic The temporary respiratory depression from magnesium sulfate is overcome by the intravenous introduction of 10 cc of a 5 per cent calcium chloride We confess to great fear relative to the parenteral use of magnesium salts and prefer the soluble barbiturates or an inhalation anesthesia because of their lesser toxicity to the vital respiratory centers

Interval Treatment—The long range view of the treatment of acute glomerulonephritis requires that the patient remain under observation until the urinary findings have been completely normal for two or three months and evidences of cardiovascular damage have dissipated We favor the *elimination of foci of infection* as soon as the acute process has subsided Infected tonsils are removed the nasal accessory sinuses are investigated and the necessary conservative and operative measures inaugurated in order to leave them relatively free from infection Diseased teeth are extracted and great efforts made to clear up pyodermas and prevent their recurrence *Prophylactic chemotherapy with penicillin* is instituted if the child is exposed to a known streptococcal epidemic such as scarlet fever streptococcal sore throat or erysipelas and similar precautions are taken in the presence of an infected wound The nephropathies constitute one field of medicine in which an ounce of prevention is worth a ton of cure

Surgery—The surgical attempt to treat glomerulonephritis by decapsulation has been abandoned as a futile form of procedure

CHRONIC GLOMERULONEPHRITIS (BRIGHT S DISEASE)

Chronic glomerulonephritis represents a permanent injury that is initiated by an attack of acute glomerulonephritis The disorder may merge imperceptibly with the acute phase but usually a latent period of several

acute infection than in those who have had a low grade chronic infection

An interesting feature of acute nephritis is the manner in which patients who have had the disease react to subsequent acute infections with hemolytic streptococci Most patients whose lesions have healed show no evidences of recurrence or at most show only a mild hematuria others suffer from recurrent exacerbations of the acute condition

Death during the acute stage occurs in less than 5 per cent of the patients The chief causes of a fatal termination are cardiac failure hypertensive encephalopathy and uremia Complete anuria for more than a short period is almost always fatal Repeated convulsive seizures are an ominous occurrence

Treatment —Compared with present pathological and physicochemical knowledge of the condition the therapeutics of acute glomerulonephritis leaves much to be desired As yet the students of this condition have not struck therapeutic gold" The best that can be done is to strive to promote healing of the renal lesion relieve the dangerous symptoms and prevent recurrences and ominous late complications

During the acute process the patient is kept *in bed* and under ideal circumstances normal activities are not resumed until the albuminuria and hematuria have disappeared Unfortunately this is usually impracticable and the patient is required to compromise with the ideal and perform only his essential activities

In view of the possible etiologic role of *chilling* the patient should be warned to keep warm at all times and should guard against sudden chilling of the body by wearing warm clothes and rubbers in inclement weather

Diet and Fluids —Dietary restriction is probably of lesser importance than would appear evident from the wealth of careful metabolic studies that have been performed on these patients In the early stages of the disease there can be no debate as to the principle of lightening the renal burden The prescribed diet (p 673) is *low in protein and sodium chloride* but rich in *carbohydrates* caloric needs are unimportant and may be disregarded *Fluids* are limited to about 1200 cc the notion of treating oliguria by flushing the kidney is unsound and carries the danger of precipitating cardiac failure The practice of the principle of renal rest by starvation and fluid restriction for three to five days is too stringent unless there are evidences of cardiac failure hypertensive encephalopathy or malignant acceleration

As the patient improves a *higher caloric diet* is given supplemented by a *multivitamin preparation* The normal amount of fluid is permitted but *sodium chloride restriction* is continued by avoiding the use of table salt in cooking or at the table until convalescence is well advanced *Restriction of protein* to the level of nitrogen equilibrium seems unnecessary and is undesirable in the presence of a hypoproteinemia Until there is convincing evidence of the noxious effect of protein it would seem best to allow the patient a normal intake of protein foods of high biological value if for no other reason than to compensate for the loss of albumin in the urine

Chemotherapy —The modern practice of early and intensive chemotherapy for streptococcal infection will undoubtedly diminish to a phenomenal degree the incidence of acute glomerulonephritis It will take at least

orrhages On cross section the cortex is broad and yellowish with numerous lipoid deposits, while the medulla has a distinctive brownish red color

Microscopically the glomeruli are enlarged. There is swelling and proliferation of the capillary endothelium and the glomerular epithelium of Bowman's capsule Some glomeruli are blocked by exudate while others are congested with blood In many glomeruli there is proliferation of the epithelium of Bowman's capsule and the formation of *epithelial crescents* Many glomeruli are transformed into hyaline masses The tubules show hyaline droplet and lipoidal degeneration Doubly refractile crystals of cholesterol esters are seen to be present when viewed with a polariscope Attempts at tubular regeneration are indicated by groups of newly formed cells with deeply staining nuclei

Hypertensive Cardiorenal Stage—In the hypertensive cardiorenal stage the kidneys are small hard and granular (*secondary contracted kidney*) The capsule is thickened and adheres tightly to the cortex making removal difficult On cross section the entire kidney is found to be shrunken The cortex is reduced to a thin narrow strip containing irregular yellowish gray areas of fibrosis and lipoid deposition The medulla is not clearly delineated and appears atrophic Thickened vessels are easily recognizable

Histological study reveals an increase in the number of hyalinized glomeruli, which are very closely set due to the general contraction of the renal parenchyma The uninvolved glomeruli and their tubules enlarge considerably in an attempt at compensatory hypertrophy There is a marked increase in the amount of interstitial connective tissue and large areas of fibrous tissue may separate the functioning tubules

The renal arterioles are always involved to a greater or lesser degree The changes may be those of an acute necrosis of the afferent arterioles an endarteritis obliterans with thickening and hyalinization of the intima, proliferation and reduplication of the internal elastic membrane and narrowing of the lumina of the vessels effecting varying degrees of renal ischemia

Extrarenal Lesions—In the nephrotic stage, there are few extrarenal lesions with the exception of the changes produced by the extensive edema In the hypertensive and vascular phase the visceral and retinal arteries are the sites of *arteriosclerosis arterionecrosis* and *endarteritis obliterans* The heart is hypertrophied particularly the left ventricle and there may be considerable sclerosis of the coronary arteries

Clinical Manifestations and Variations

The clinical features of chronic glomerulonephritis are not distinctive but closely resemble those of other varieties of hypertensive cardiovascular renal disease In some instances the history of acute nephritis is the principal feature that distinguishes the disease from chronic nephrosis or essential hypertension For simplicity the principal clinical variants are presented here as separate entities but the patient usually manifests a combination of these symptom complexes and transitional types are relatively common

The Nephrotic Phase —The outstanding feature of the fully developed nephrotic phase is a marked generalized *edema* associated with *albuminuria* and *hypoproteinemia* (p 706) The edema is believed to result from the steady urinary loss of serum albumin The resultant depletion of the blood of plasma protein allows the escape of plasma into the interstitial tissues

The onset may follow closely upon an attack of acute glomerulonephritis or there may be a lag of months or years In some patients there is no history of an acute attack The extensive *edema* pits easily on pressure and is most marked in the lax subcutaneous tissues and in the lower parts of the body The scrotum and vulva become greatly swollen There may be moderate *ascites* and collections of edema fluid elsewhere in the serous cavities Edema of the gastro intestinal tract causes *anorexia* and *diarrhea* The edema fluid is opalescent and has a protein content of less than 1 per cent

years intervenes before the chronic disturbance becomes manifest The symptom complex may consist of a *nephrotic or edematous stage* and/or a *hypertensive cardiorenal phase* The latter may be indistinguishable from an *essential hypertension* (p 900) and the former resembles the syndrome of *lipoid nephrosis* (p 2389)

Etiology—There is at present no satisfactory explanation of the factors that influence recovery from acute glomerulonephritis so that some patients recover completely while others go on to develop chronic disease The kidneys of chronic nephritis are hypersensitive to the nucleoprotein of hemolytic streptococci and react to their presence with transient hematuria,



Fig 570—Hard contracted granular state of kidney connected with secretion of albuminous urine obstinate anasarca and effusion into cavities

thus the crux of the problem may depend on a state of *hypersensitivity* and *desensitization anergy* in those who recover *Constitutional factors* may be involved since acute nephritis is more apt to become chronic in adults The possible bearing of *hormonal influences* is suggested by the fact that *pregnancy* increases the severity of chronic glomerulonephritis and may precipitate a rapidly fatal uremia Finally the influence of *renal ischemia* on hypertensive vascular disease must be considered in the pathogenesis of the disease (p 22,3)

Pathology—The pathologic findings in chronic glomerulonephritis, depend upon the phase of the disease in which death occurs

Nephrotic Stage—In the nephrotic stage the kidneys are large pale and heavier than normal The capsule strips easily revealing a yellowish white surface dotted with small hem-

* From "Reports of Medical Cases selected with a view of illustrating the symptoms and cure of diseases by reference to Morbid Anatomy" By Richard Bright, F.R.S Physician to Guy's Hospital, London 1827

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The *blood pressure* usually reveals a tendency to moderate hypertension but in children the readings may be normal Ultimately as the disease progresses to the hypertensive cardiorenal stage there is a marked degree of *persistent hypertension*

Laboratory Data—The *urine findings* depend on the status of the edema The volume is small while edema is forming and large during diuresis The specimen often has a dirty brown color and rapidly becomes foul on standing Large amounts of urinary *albumin* are a constant finding and a copious *albuminuria* may be present for months or years When impairment of renal function occurs in the stage of the secondary contracted kidney the quantity of albumin diminishes

The urinary sediment reveals hyaline granular epithelial and waxy *casts* and there is also some degree of microscopic *hematuria* The blood chemical studies show a *diminution in the serum protein concentration* particularly of the albumin fraction *inversion of the albumin globulin ratio* increase in fibrinogen *hypercholesteremia* and *hypocalcemia* due to the loss of calcium in the urine in combination with albumin Occasionally the hypocalcemia is sufficiently marked to cause *tetany* (p 723) The nonprotein nitrogen urea uric acid and creatine figures are normal but the amino acid concentration is reduced The *basal metabolic rate* is low and there is an interesting and as yet obscure refractoriness to the calorigenic activity of thyroid extract whether given orally or intravenously (p 1189)

The functional capacity of the kidney is unimpaired with respect to the ability to excrete metabolic wastes and there are no characteristic changes in the excretion of electrolytes Some patients in nephrotic crises (see below) have intermittent periods of increased nonprotein nitrogen excretion

Course and Complications—The nephrotic has an increased susceptibility of skin and peritoneum to various types of infection particularly those caused by *pneumococci* and *hemolytic streptococci* These infectious episodes are classified as *nephrotic crises*

The complicating *dermatosis* is usually an erysipeloid lesion which appears on the lower abdomen and thighs It is associated with a sudden chill and sharp rise in temperature to 103° or 104° F The acute episode lasts twenty four to forty eight hours and then subsides

Peritoneal infection is announced by an abrupt rise in temperature nausea vomiting generalized abdominal pain and rigidity and a marked leukocytosis Blood cultures usually reveal the presence of *pneumococci* but hemolytic streptococci colon and influenza bacilli occasionally have been isolated Aspirated peritoneal fluid discloses many polymorphonuclear leukocytes and the pathogenic organism Sometimes the attack terminates within twelve to forty eight hours but in other cases there may be persistence of a diffuse peritonitis and a bacteriemia resulting in death in one or two weeks

The *nephrotic crises* are regularly preceded by an increased urinary excretion of nonprotein nitrogen and a negative nitrogen balance There is a simultaneous drop in the concentrations of serum albumin and plasma amino acid nitrogen Following the crisis the serum albumin and amino-acid nitrogen figures rise suggesting that the crisis resulted from a sudden decrease in the resistance to an organism towards which the patient had

acted previously as a carrier The breakdown of immunity may be caused by a hypo amino acidemia or by an unknown metabolic disturbance lead ing to a negative nitrogen balance and hypo amino acidemia Intravenous nutrition with amino acids seems beneficial in reducing the mortality from this complication

The nephrotic stage may last for months or years in the absence of impaired renal function or hypertension The edema and hypoproteinemia are extremely refractory to treatment but it is not uncommon for the syndrome to disappear spontaneously after an acute infection The neph rotic stage may recur from time to time or be followed by an interval period in which there are few evidences of abnormality except the albu minuria Eventually persistent hypertension appears and a progressive in volvement of renal function becomes manifest Death is uncommon during the nephrotic stage When it occurs it is caused by the complicating in fection of the nephrotic crisis

Hypertensive Cardiovascular Renal Stage —The patient with chronic glom erulonephritis sooner or later enters upon the final phase of hypertensive cardiovascular renal disease Some do so directly after an attack of acute nephritis while others pass through a period of nephrotic edema The course of the terminal manifestation may be benign or accelerated (malignant)

Benign Type —Most patients with chronic glomerulonephritis display a low and rather uneventful downhill course to fatal renal insufficiency Less often death results from cardiac failure or a cerebral vascular acci dent

The principal clinical feature is a persistent moderate *hypertension* approximating 200/120 The readings are relatively fixed but there is a tendency for the tension to increase as the disease progresses Sooner or later the blood pressure elevation leads to *cardiac dilatation* and *hyper trophy* Recurrent episodes of *cardiac pain* are frequent and *cardiac de compensation* may be encountered with signs of congestion of the pulmo nary and systemic circulations

Other manifestations related to the hypertension are severe frontal and occipital *headaches* and recurrent *nosebleeds* Often the epistaxis relieves the headache Occasionally the headache is associated with nausea vomit ing and stiffness of the neck suggesting the presence of a *subarachnoid hemorrhage* (p 1445) Episodes of *hypertensive encephalopathy* (p 2376) with *convulsions amaurosis* and *hemiparesis* may occur

Examination of the *retina* often reveals the typical findings of a *hyper tensive neuroretinopathy* The optic disk has indistinct margins There may be a marked degree of *papilledema* and numerous white *retinal exu dates* are present as soft cotton wool blotches or hard deposits with sharply defined margins In the region of the macula a stellate figure made up of hard white spots arranged linearly about the fovea centralis is frequently seen Round and flame shaped *hemorrhages* are often present

The *retinal arteries* appear narrow and markedly con tricted There is a prominent light reflex giving a silver or copper wire appearance on ophthalmoscopy (p 1545) The *veins* are prominent in comparison to the narrow arteries and arteriovenous compression is apparent Detachment of the retina (p 1573) may occur and other complications include thrombosis of the central artery or vein and intra ocular hemorrhage

In the benign phase the outcome is determined by the rapidity with which severe renal insufficiency occurs In most patients renal function even though impaired remains adequate for years In these there is a moderate *polyuria* of 2 to 3 liters daily and *impairment of renal concentrating power* with a maximum urine specific gravity of 1 010 (p 2240) The excretion of *phenolsulphonphthalein* (p 2242) is reduced and the *urea clearance* (p 2241) may be less than 20 per cent of normal The patient drinks fairly large volumes of water because of an exaggerated *thirst Nocturia* several times nightly is common In this stage an adequate level of renal function is maintained by the compensatory polyuria but eventually this mechanism becomes inadequate and uremia ensues

The urine contains a slight or moderate amount of *albumin* in contrast to the marked albuminuria of the nephrotic stage *hematuria* also is only slight A sudden increase in hematuria usually signifies an exacerbation of an acute nephritis or the onset of the accelerated type of the disease

Some degree of *anemia* is always present and is partially responsible for the grayish pallor It is usually hypochromic but occasionally may be hyperchromic and macrocytic (p 1077) There is almost always a moderate elevation of the *nonprotein nitrogen*

COMPLICATIONS —The occurrence of an acute upper respiratory infection is usually followed about twenty four to forty eight hours after the onset of fever by an increase in hematuria hypertension and the development of edema There is a definite decrease in renal function which is often transient but which may be permanent Occasionally the acute flare-up follows exposure to cold These attacks are considered recurrent episodes of acute nephritis superimposed upon the chronic glomerulonephritis

Long standing chronic renal insufficiency in patients with chronic glomerulonephritis is associated with *osteoporosis* Some patients develop clinical evidences of *osteitis fibrosa cystica* and *hyperparathyroidism* More often cardiovascular complications are superimposed as vascular accidents circulatory failure or renal insufficiency

Accelerated (Malignant) Type —A small group of patients with chronic glomerulonephritis run a severe acutely progressive course characterized by marked hypertension and the rapid onset of renal insufficiency These unhappy experiences are similar in almost every respect to the accelerated or malignant phase of *essential hypertension* (p 908) The clinical course is stormy the *blood pressure* is markedly and progressively elevated the readings approaching 300/160 and severe *headache somnolence convulsions* and *visual disturbances* are frequent There may be recurrent episodes of *paroxysmal dyspnea anginal pain* and frank *cardiac decompensation* Death occurs in *uremic coma* a fatal episode of *hypertensive encephalopathy* or *cardiac failure*

The findings are a combination of the clinical features of the benign type of the hypertensive phase of chronic glomerulonephritis and the encephalopathy of acute glomerulonephritis (p 2373)

This phase of the disease may follow quickly after acute nephritis or may develop suddenly in a patient whose course had been previously benign Not infrequently it has its onset during *pregnancy* As in the other types of chronic nephritis it may be present as the first clinical evidence of the disease In all probability the accelerated phase develops as part of

the vicious cycle The arteriolar necrosis and endarteritis obliterans resulting from the marked hypertension intensify the degree of renal ischemia which in turn increases the degree of hypertension A similar mechanism is believed to be involved in the evolution of the malignant phase of essential hypertension

Laboratory Data

The urinary findings indicate the presence of an acute inflammatory lesion There is considerable *albuminuria* and a well marked *hematuria* *Renal function* is considerably diminished as indicated by inability to concentrate the presence of *azotemia* and retention of *inorganic phosphorus*

Differential Diagnosis

For Nephrotic Phase see *Edema* (p 717) *Hypoproteinemia* (p 706)
For Hypertensive Phase see *Hypertension* (p 910)

Treatment

The practitioner s best but least appreciated efforts are directed toward the prevention of chronic glomerulonephritis Once the condition has been established the most that he can accomplish is a reduction in the tempo of the progress of the disease and the initiation of measures directed at symptomatic relief

Prophylaxis —The prevention of chronic glomerulonephritis is attempted in the treatment of acute glomerulonephritis (p *2378*) *Once Bright s disease* has developed the unfavorable course of the disease and particularly the onset of the nephrotic crises (p 2382) may be favorably affected by relief of urinary obstruction and stasis (p 2264) the elimination of urinary sepsis (p 2353) eradication of focal infection in the tonsils teeth and nasal accessory sinuses and the prompt administration of anti infective agents (p 106) when the patient is exposed to virulent micro organisms particularly the hemolytic streptococci

The efficacy of *climatotherapy* in a subtropical region such as Florida California or the desert states is extremely dubious The general discussion of transplantation of the patient with chronic illness (p 3762) is particularly applicable to the problem of chronic nephritis

Symptomatic Therapy —The symptomatic therapy of Bright s disease depend upon the nature of the clinical manifestations Diametrically opposite metabolic considerations govern the requirements in the nephrotic and the hypertensive cardiovascular phases

In the Nephrotic Phase —Whereas urinary stasis and sepsis seem to be of relatively minor significance in the nephrotic syndrome we have been impressed with the importance of *local infection* in the tonsils and nasal accessory sinuses Occasionally the history and obvious findings point to the source of the difficulty but more often the disturbance is insidious and detectable only when scrupulously sought by the specialist rhinologist Even radiological evidences may be misleading and it is the duty of the practitioner to insist upon direct examination and diagnostic lavages Despite technical difficulties children a well as adult may be investigated in this manner If there are no strikingly positive findings we favor *tonsillectomy*

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Long standing chronic renal insufficiency in patients with chronic glomerulonephritis is associated with *osteoporosis* Some patients develop clinical evidences of *osteitis fibrosa cystica* and *hyperparathyroidism* More often cardiovascular complications are superimposed as vascular accidents circulatory failure or renal insufficiency

Accelerated (Malignant) Type —A small group of patients with chronic glomerulonephritis run a severe acutely progressive course characterized by marked hypertension and the rapid onset of renal insufficiency These unhappy experiences are similar in almost every respect to the accelerated or malignant phase of *essential hypertension* (p 908) The clinical course is stormy the *blood pressure* is markedly and progressively elevated the readings approaching 300/160 and severe *headache somnolence convulsions* and *visual disturbances* are frequent There may be recurrent episodes of *paroxysmal dyspnea anginal pain* and frank *cardiac decompensation* Death occurs in *uremic coma* a fatal episode of *hypertensive encephalopathy* or *cardiac failure*

The findings are a combination of the clinical features of the benign type of the hypertensive phase of chronic glomerulonephritis and the encephalopathy of acute glomerulonephritis (p 2373)

This phase of the disease may follow quickly after acute nephritis or may develop suddenly in a patient whose course had been previously benign Not infrequently it has its onset during *pregnancy* As in the other types of chronic nephritis it may be present as the first clinical evidence of the disease In all probability the accelerated phase develops as part of

protein dietotherapy have been strengthened by experimental observations that the extent of compensatory regeneration of renal tissue is inversely proportional to the amount of protein in the diet

When the experts disagree it is wise for the practitioner to take an intermediate position Thus it is our practice to attempt to maintain *nitrogen balance* by advising the ingestion of approximately 1 gm of protein per kilogram (2 2 pounds) of body weight The protein should be of high biological value and may be derived from animal or vegetable sources It is perhaps unnecessary to mention again that there is no essential chemical difference between red and white meat

In contrast to the conditions that prevail in the management of the nephrotic phase those patients with dry Bright s disease often require increases in *fluid* and *salt intakes* In renal insufficiency considerable water is required to assist in eliminating waste and to compensate for the necessarily large quantities of urine that are passed by patients who have a fixation of the urinary specific gravity (p 2240) Again in renal insufficiency large amounts of salt may be swept out in the urine producing a hyponatremia manifested clinically by symptoms such as nausea The latter are often alleviated by the deliberate ingestion of small amounts of saline solution

In Malignant Hypertension—In malignant hypertension efforts are made to control the manifestations referable to the encephalopathy Intracranial tension is reduced by *lumbar puncture* (p 3781) and the intravenous introduction of *hypertonic sugar solutions* such as 50 per cent dextrose or preferably 50 per cent sucrose Either of the latter may be given in 50 to 200 cc amounts by slow intravenous drip and injections may be repeated at four to twelve hour intervals

At the slightest suggestion of convulsive phenomena the above measures are reinforced by the administration of sedative drugs The impairment of renal excretion favors the retention and cumulation of most therapeutic agencies particularly the opiates Our personal choice is for the use of the simpler preparations such as *paraldehyde* (p 3845) best given intravenously by slow injection *chloral hydrate* (p 3836) administered by mouth by intramuscular injection of a sodium phenobarbital or by the intravenous introduction of sodium pentothal

We confess to a great fear concerning the use of *magnesium sulfate* because of its tendency to produce udden and complete respiratory depression Those who advocate the injection of magnesium sulfate use 10 to 20 cc of a 10 per cent solution intravenously or 15 cc of a 20 per cent solution intramuscularly The pharmacological antidote (10 cc of 5 per cent calcium chloride) is kept at hand in another syringe for intravenous introduction upon the first manifestations of respiratory depression Needless to say intravenous injection must be given very slowly and intramuscular introduction is preceded by the preliminary instillation of a small amount of a local anesthetic such as 1 per cent procaine (p 3915)

Plethoric patients in the hypertensive phase often benefit from a generous phlebotomy No less than 500 cc are removed and if all goes well as much as 800 cc safely may be withdrawn

The use of drugs and surgical measures intended to reduce the hypertension are ineffectual and ill advised in the presence of marked renal in

which occasionally reveals a central abscess not suspected as the result of ordinary inspection

Those who have evidenced manifestations of the nephrotic syndrome require protection for the remainder of their lives against *chilling* and *bacterial invasion* The complete schedule of *prophylactic immunization* (p 80) is carried out and anti infective agents are administered promptly when there is known exposure to a virulent invader

In the nephrotic phase *dietotherapy* consists of a *high protein intake* (p 674) with sharp limitation of fats fluids and salt When there is massive edema the daily intake of *protein* may be forced to 200 or 300 gm Plasma infusions are desirable when blood proteins are low and the stomach is intolerant The limitation of fatty substances should be as complete as possible but water and salt deprivation need not be so rigid Fluids may be maintained at 1500 to 2000 cc daily and the sodium chloride intake should be held at approximately 1 gm by forbidding the use of table salt during the course of the meal

In the presence of massive edema that does not respond to dietotherapy the blood proteins are directly increased by transfusions of whole blood or by intravenous administration of plasma or mixtures of the vital amino acids (p 3825)

The presence of the low basal metabolic rate calls for the administration of *thyroid extract* (p 1189) which often must be given in tremendous dosages in order to affect favorably the oxygen consumption Even children occasionally require as much as 5 to 25 grains daily Overdosage is prevented by frequent estimations of the basal metabolic and pulse rates If the oral administration is unsuccessful *thyroxin* (p 1189) is administered by intravenous injection beginning with 5 mg

The use of *diuretic drugs* is best delayed until there has been a complete evaluation of the efficacy of the metabolic measures above described When adjuvant therapy has been decided upon it is best to use the least noxious preparations reserving the potentially nephropathic drugs for desperate situations In the order mentioned the patient is given *ammonium chloride* (p 614) 3 to 6 gm daily for no longer than a five-day period or *urea* (p 2260) 50 to 100 gm daily in fruit juice tomato juice or beer The use of the *mercurials* (p 2261) is a final resort whose dramatic diuretic response is often followed by a period of anti diuresis with a reaccumulation of edema to a pretreatment level

In the Hypertensive Phase—In the hypertensive phase of a chronic glomerulonephritis management is first directed towards the discovery of an underlying *urinary stasis obstruction* or *sepsis* *Focal infection* in contrast to the conditions that prevail in the nephrotic syndrome is of little or no importance Tonsillectomy is not warranted and may be complicated by postoperative hemorrhage Extensive investigations of the nasal accessory sinuses have the hazard of precipitating a vascular accident

In the hypertensive cardiovascular renal stage of Bright s disease there are conflicting opinions concerning protein intake The advocates of a *high protein diet* point to improvement in well being and the increased vigor that follows an adequate protein ration They believe that much of the depletion and anemia of former days resulted from the protein starvation that was an integral part of the therapeutic regime The proponents of *low*

sufficiency The elevation of blood pressure in chronic glomerulonephritis is a result of an effort to combat renal ischemia Were therapeutic efforts successful in terms of the sphygmomanometer they would have disastrous results as measured by kidney function

Shifting Treatment During the Course of the Disease—The practitioner must be prepared to shift his therapeutic routine with the evolution of the metabolic changes in Bright s disease (Table 135) The nephrotic eventually loses his edema and may progress to the hypertensive phase Conversely the dry nephritic becomes waterlogged as the result of progression to a nephrotic phase or the development of circulatory failure

LIPOID NEPHROSIS

The term *nephrosis* was originally intended to distinguish degenerative from nephritic or inflammatory lesions of the kidney The clinical manifestations of the *nephrotic syndrome* are elsewhere described in detail (p 2372) Briefly they consist of massive edema albuminuria relatively normal renal function and the presence of a hypoproteinemia hypercholesterinemia and a diminution of the basal metabolic rate

It is the majority opinion that nephrosis is not a disease entity but a *symptom complex* that occurs as one phase of *chronic glomerulonephritis* (p 2379) *renal amyloidosis* (p 2369) *diabetic glomerulosclerosis* or *syphilis* Against the majority view is that of Volhard and Fahr in Europe and Epstein in America who regard *lipoid nephrosis* as a *separate disease* resulting from a disturbance of protein metabolism

In our opinion this controversy is purely academic however since it does not affect the therapeutic approach

Etiology—The nephrotic syndrome is probably always caused by some variety of renal disease The essential defect is an injury to the glomerular membrane which allows serum albumin to escape into the urine thus depleting the blood of its principal osmotic constituent The commonest cause is *chronic glomerulonephritis* in which the syndrome is observed as the nephrotic stage of the disease It may occur after an attack of acute glomerulonephritis has subsided almost completely or it may blend imperceptibly with the acute stage If acute nephritis with heavy albuminuria persists for five weeks a serious albumin deficiency may be expected by the end of this time

Patients with *renal amyloidosis* develop the syndrome not infrequently as a stage in the natural history of the disease whose mode of progression is quite similar to that of glomerulonephritis It is seen also in a small group of elderly *diabetics* with advanced arteriosclerosis and whose kidneys reveal a type of glomerulosclerosis The syndrome has been observed in patients with secondary syphilis and has been regarded as a manifestation of an *acute syphilitic nephritis*

Epstein believes that in certain patients there is a *primary disturbance of protein metabolism* resulting in the formation of abnormal plasma proteins which are excreted promptly as *foreign protein* by the normal kidney Bell on the other hand regards these occurrences as forms of a glomerulonephritis in which the glomeruli are damaged but their capillaries are only partially obstructed so that they continue to function

Pathogenesis—The physiological study of the nephrotic syndrome has contributed much to knowledge of the mechanisms involved in edema formation and normal water balance The basic factor responsible for the production of the generalized edema of patients with the nephrotic syndrome is *hypoproteinemia* This is attended by a *decrease in the colloid osmotic pressure of the plasma* which allows fluid to pass freely from the vascular compartment into the tissue spaces in accordance with Starling s law The hypoproteinemia is due in large part to the loss of albumin in the urine resulting from increased permeability of the glomerular capillaries but there is also evidence to show that the synthesis of plasma proteins is defective in these patients

TABLE 135.—TREATMENT OF CHRONIC NEPHRITIS

	Edema	Edema and Hypertension	Edema and Acidosis	Azotemia	Azotemia and Acidosis	Azotemia and Hypertension	Azotemia and Edema
Protein	High	High	High*	Basic	Basic	Basic	Basic
Salt	Poor	Poor	Poor	1–3 gm in capsules†	1–3 gm in capsules†	1–3 gm in capsules†	1–3 gm in capsules†
Fluids	1500 cc	1500 cc	1000–1500 cc	3000–5000 cc	3000–5000 cc	3000 cc.	2500 cc
Intravenous Dextrose	For vomiting	For vomiting	For vomiting	For vomiting	For vomiting	For vomiting	For vomiting
Plasma	Useful	Useful	Useful	Useful	Useful	Useful	Useful
Diuretics	Ammonium chloride	Ammonium chloride					
Sodium Lactate			300 cc of ⅙ molar solution by vein		500 cc of ⅙ molar solution of vein		
Sodium Bicarbonate			3–6 gm by mouth		3–6 gm daily by mouth		

2000–3000 cc of Milk with Aluminum Hydroxide
† In addition to salt of diet

SECTION XV

THE MALE REPRODUCTIVE SYSTEM

Associate Editors MOSES SWICK M D

CLIFFORD R SPINGARN M D

Hypoproteinemia bears an interesting relation to the *lipemia* which is a characteristic feature of the syndrome The serum has a milky appearance and there is an increase in the concentration of almost all the fatty constituents Lipemia occurs in almost all patients with the nephrotic syndrome but may be absent in the presence of emaciation It may be produced experimentally by plasmapheresis (Leiter) For obvious reasons it is not to be expected in nutritional hypoproteinemia

Clinical Manifestations —The cardinal clinical features of the nephrotic syndrome are generalized edema massive albuminuria hypoproteinemia lipemia unimpaired renal function a low basal metabolic rate and an increased susceptibility to infections A detailed description of the syndrome as it is encountered in each of the diseases in which it occurs is presented elsewhere See *Chronic Glomerulonephritis* (p 2379) *Renal Amyloidosis* (p 2362) *Diabetic Glomerulosclerosis* (p 2372)

The clinical picture of so called lipoid nephrosis is believed by its adherents to differ from the nephrotic stage of chronic glomerulonephritis chiefly with respect to its course Patients with the latter disease go on to develop the hypertensive cardiovascular renal stage of the disease (p 2383) while those with true lipoid nephrosis are said to recover completely or die from an acute intercurrent infection This distinction is not completely valid since the favorable course of some patients with lipoid nephrosis may represent the final healing of a glomerular lesion of the nephritic type

Course —The course of the nephrotic syndrome varies A very few of the afflicted become free from all clinical manifestations and apparently effect a recovery which may be maintained for many years Others remain in a static condition and do not suffer from their disturbance beyond the mechanical nuisance of the edema In our experience however the vast majority of the cases follow less favorable courses Young children particularly females succumb to a nephrotic crisis most often a *pneumococcus peritonitis* (p 1929) or some other manifestation of bacterial invasion Others progress to the phase of *hypertensive cardiorenal disturbances* and eventually succumb to a *vascular accident* (p 1439) *renal insufficiency* (p 2275) or a *malignant hypertensive encephalopathy* (p 2376)

Treatment —In our opinion the treatment of lipoid nephrosis should be that of the *nephrotic phase of chronic glomerulonephritis* (p 2385) In the presence of *amyloidosis* injections of *liver extract* (p 1081) are added and an attempt is made to correct the condition productive of the amyloid deposits (p 7) *Syphilitics are treated with penicillin* (p 106) which has not the nephrotoxic potential of arsenic mercury or bismuth (p 116)

The symptomatic treatment of the edema is elaborated elsewhere (p 706)

CHAPTER 113

INTRODUCTION PHYSIOLOGY METHODS OF DIAGNOSIS AND TREATMENT

The male reproductive system con ists of copulative secretory and ex cretory components The penis functions in sexual intercourse and serves to ejaculate sperm the testes are the sites for spermatogenesis and the sources for the derivation of androgen Secretory elements of a less defini tive nature are contributed by the seminal vesicles the prostate gland and the bulbo urethral glands of Cowper The seminal excretory system be yond each testis includes the epididymis the vas deferens the ampulla and the ejaculatory ducts which open into the prostatic portion of the urethra

ANATOMIC REVIEW

The Pen s—The penis is composed of three cyl ndrical masses of erectile tissue bound together by fibrous tissue and covered with skin The two lateral masses are the *corpora ca ernosa* the third or median mass is the corpus spong osum The *corpora a erno a* form the greatest part of the body of the penis In the anterior three-fou ths they are intimately connected along the median line At the posterior portion they separate to form the *crura penis* two st ong tapering fibrous processes or roots that are firmly connected to the rami of the os pubis and ischium A median groove on the upper surface of the corpora lodges the dorsal arteries nerves and veins The groove on the under surface receives the corpus spongiosum The *corpus spongiosum* which contains the urethra is expanded behind to form the *u eth al bulb* This lies in apposition to the superficial layer of the triangular ligaments

The anterior extremity of the spongiosum is expanded to form the *glans penis* wh ch is molded over the rounded ends of the corpora cavernosa extending further on their upper than their lower surfaces At the summit of the glans is the urethral orifice or *meatus* The circumference of the base of the glans forms the *corona* as a rounded, project ng border which overhangs a deep socket behind which is the neck of the penis The *prepuce* is a lay r of redundant k n that encir les the neck of the penis and may be drawn over the glans

The penis is divided for descriptive purposes into a root, a body and an extr m ty The *root* consists of the diverging crura and the mes al bulb of the corpus spongiosum Each crus s covered by the erector pen s The bulb is surrounded by the accelerator urinae The *body* of the penis ext nds from the root to the end of the corpora ca e nosa wh le the e trem ty is formed by the glans co ered by the prepuce

Th M le Ur thra—The male urethra extends from the neck of the bladder to the meatus at the nd of the penis Its funct ons and form are modifi d by abnormalities in the seminal organs particularly lesions affecting the prostate gland Con ersely the reproductive structures ar secon larily involved with urinary lesions particularly urethritis of venereal origin The male urethra is subdivided by the external sphincter into an anterior and a posterior port on

Anterior Ureth a—The anterior urethra begins at the urethral meatus a vert cal slit at the end of the glans penis *Norm ally the meatus is at the summit of the glans* Due to con gen tal abnormal t es howe r it may occupy aty pi al locat ons See *Ep spad as* (p 2286) *Hyp spadias* (p 2280) The al ber of the urethral meatus is small and th t s ue is relatively inelastic It ordinarily approximates 8 mm in diameter It may require splitting (meatotomy) in order to pass instru ments larger than 24 F

The *fi st portion* of the anterior urethra extends from the meatus to the level of the corona. The lumen is fus form and forms the *fossa navicularis* The neck of this fossa l ke the meatus may be of small cal ber and often requires spl tt ng for instrumentation Folds small valves and edupl cat ons of the mucous memb ane, which occur in the region of the fossa, may produce obstruction to urinary flow They also serve as foci for chronic infection,

lective investments of the testes The scrotum functions as thermoregulator for the testes since these organs undergo atrophy at intra abdominal temperature

The skin of the scrotum is thin It contains sebaceous glands and hair follicles The surface is divided symmetrically into lateral halves by a *median raphe* which runs from the penis along the scrotum to the anus *Dermoid cysts* are occasionally encountered in the

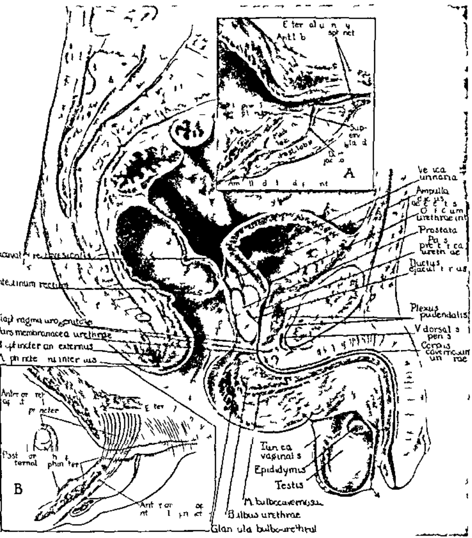


Fig 2—Sagittal section through the male pelvis perineum and external genitalia *A* is a sagittal section through the neck of the bladder and the prostate *B* is a diagram of the musculature at the vesical orifice

raphe From the raphe rugae run at right angles corresponding to the dermal muscle fibers Just beneath the scrotal skin is the *dartos* consisting of elastic and smooth muscle fibers and connective tissue The dartos is vascular and forms a sac for each testis Careful hemostasis must be observed in injuries or operations involving this tissue The scrotum

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particularly *gonorrhea* The *second portion* of the anterior urethra is the pendulous division which traverses the corpus spongiosum The caliber of the spongy urethra is fairly uniform throughout The pendulous *portion of the* anterior urethra gives in to *the third or bulbous segment* which broadens throughout due to a ventral sagging producing a pouch or bulb At the junction of the bulbous *segment with the* posterior urethra there is a narrowing and a sharp angulation These factors produce difficulty in the passage of instruments and favor the formation of inflammatory *strictures Accessory glands* are present in the spongy and bulbous segments of the anterior urethra The *submucous glands of Littre* open directly onto the surface of the spongy portion The *bulbo urethral glands of Cowper* open into the bulbous portion These *glands often harbor* chronic inflammation particularly in gonorrheal infection

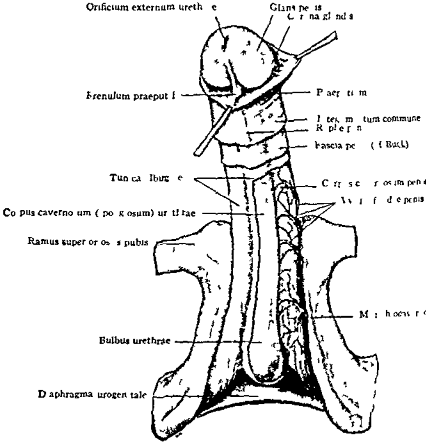


Fig 571 —Structure of the penis and its relationship to the symphysis pubis

Posterior Urethra —The posterior urethra leads from the bulbous portion of the anterior urethra to the urinary bladder It is subdivided into a membranous or muscular portion and a prostatic segment The *membranous portion* of the posterior urethra is short Its junction anteriorly with the bulbous division of the anterior segment is a common site for deep urethral strictures The external sphincter encircles this portion The *prostatic portion* of the posterior urethra extends from the vesical orifice posteriorly to the membranous urethra anteriorly This segment is surrounded throughout by the prostate gland The lumen of the prostatic urethra is dilated Many ducts of the seminal organs open directly into it

The *floor* of the prostatic urethra is elevated into a crest the *verumontanum* To the right and left of this structure the *prostatic sinuses* are recognized Into these the major y of the *prostatic ducts* open The verumontanum or urethral crest is itself produced by the *ejaculatory ducts* and the *utricle*

The Scrotum and Tunics of the Testes.—The scrotum and the testicular tunics are pro-

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The Testes—The testes are almost symmetrical oval greyish white bodies measuring about 4 cm in their greatest dimension. They are situated in the scrotum and are surrounded by the testicular tunics. The left testis usually occupies a level lower than that of the right. *The long axis of the testis is not quite vertical. It is slightly upward, lateral and forward.* The anterior surface is free. The posterior surface is covered by the epididymis.

The structural unit of spermatogenesis is the *seminiferous tubule*. This structure averages 1 to 3 feet (30 to 91 cm) in length though its mean diameter is only 150 to 200 mm. Each testis may have as many as 600 to 1200 seminiferous tubules having a combined length of almost half a mile[1]

In the cortex of the testis the canals are tortuous and form the *ductuli contorti*. These unite to form connecting canals which in turn form the straight canals or *ductuli recti* and enter the *rete testes*. Within the seminiferous canals the cells show a continuous process of maturation beginning with the *spermatogonium* and proceeding through the *spermatocyte*, the *spermatid*, and finally the free swimming *spermatozoa*. In this cellular metamorphosis the number of chromosomes of each cell is reduced by one half, a process analogous to that which occurs in the female ovum during the formation of polar bodies.

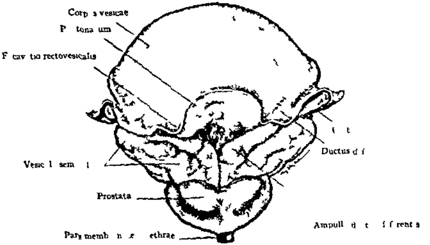


Fig 574 —Posterior view of the bladder and male pelvic genitalia

The entire spermatogenic tubular system is encased by the *tunica albuginea* which sends radiating septa down through the substance of the glands. Within the fine ramifications of the tunica are the *interstitial cells of Leydig* which have an internal secretory function.

The Epididymis—The epididymides are structures situated bilaterally that cover the posterior surfaces of the testes. Grossly three portions are recognizable: the *globus major* or head, the *corpus* or body and the *globus minor* or tail. The globus major is made up by 12 to 15 efferent ductules which open directly into the coiled canal of the epididymis. These coils are bound firmly by a framework of connective tissue into a compact body. Eventually the canals open each into the other until beyond the globus minor the lumen enlarges to form the *vas deferens*.

Vas Deferens, Spermatic Cord, and Vessels of Male Genitalia—The *vas deferens* or *spermatic duct*, a direct continuation of the epididymis, is a firm cylindrical muscular tube 15 to 18 inches long. It leads through the spermatic cord and the inguinal canal along the pelvic rim where it winds around the iliac fossa extraperitoneally and loops over the ureter to reach the base of the bladder. Here it enlarges three- or fourfold to form the *ampulla* and joins the duct of the seminal vesicle at the base of the prostate to form the *ejaculatory duct*. The vas deferens has five recognizable subdivisions: a *testicular portion* contained in the tunica vaginalis, the *scrotal segment* palpable up to the external inguinal ring, the *inguinal portion* which runs in the canal, the *abdominopelvic division*, and the final *vesicoprostatic portion* or ampulla which joins with the duct of the seminal vesicle.

[1] After Wesson, Callander, Surgical Anatomy

varies greatly in size due to the action of the dartos In elderly and debilitated individuals, it tends to be pendulous Undue warmth has a similar effect Cold exercise and emotion cause contraction

Included as investments for the testes are the *tunics* which are derived intra abdominally and transabdominally in the course of the descent of the testes from the intra abdominal position to its location in the scrotum The visceral and parietal layers of the tunica vaginalis are derived from peritoneum the infundibuliform fascia from the transversalis muscle the cremasteric from the internal oblique muscle and the intercolumnar from the external

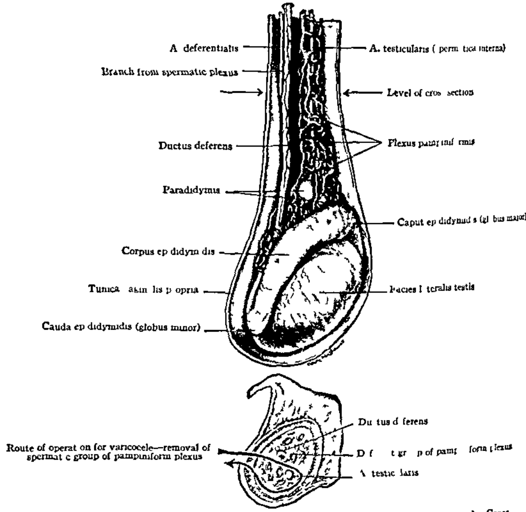


Fig 573—Lateral view and cross section of the right spermatic cord and testicle Cross section illustrates the removal of the spermatic group of veins of the pampiniform plexus for varicocele

oblique muscle The tunica vaginalis completely invests the testis and epididymis except at the point of contact between the two and posteriorly where the blood vessels and nerves enter The most dependent part of the scrotum and the tunica are connected by the scrotal ligament.

In the region of the tunica, there are certain vestigial structures mainly of interest to the specialist These are the appendix testes the appendix epidi lymis the paradidymis and the vasa aberrantia These structures have only embryological significance Occasionally they become cystic

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shoulders become broader and the boy begins to take on the appearance of the man

Under abnormal conditions puberty may be delayed (p 2412) or it may occur prematurely (p 2418) The changes are dependent on the integrity of testicular secretion and the interrelationships between the gonadotropic hormone of the anterior pituitary gland and the secretions of the thyroid gland and the adrenal cortex

Spermatogenesis —The production of *spermatozoa* is a principal function of the seminiferous tubules of adult testicular tissue Spermatogenesis is controlled by the combined activities of androgen and *anterior pituitary* gonadotropic hormone (p 1153) The cells develop from the primary *spermatogonia* which rest on the basement membrane of the seminiferous tu

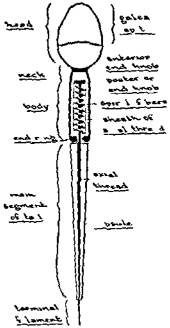


Fig 5 5 —Minute structure of normal spermatozoon

bules The primary spermatogonia divide into smaller cells which then undergo a period of growth Upon attaining full size there are two maturation divisions as the result of which four spermatids are formed These are the immediate forebears of ripe spermatozoa and each possesses one half of the number of chromosomes present in the primary spermatogonia

The mature permatozoa being actively motile enter the seminal tract and are carried to the *seminal* vesicles and the *ejaculatory ducts* Their progress is the result of their inherent motility and the action of the ciliated epithelium of the tract They appear in the normal seminal fluid between the ages of fourteen and sixteen Each cell is slender motile and flagellated It measures 5ɔ to 6ɔ microns and consists of an elliptical head which contains the nucleus a narrow middle piece and a tail or flagellum

Aft r Me es and Bonn t Herman The Practice of Urology

The *spermatic cord* is the testicular pedicle extending from the internal abdominal ring through the inguinal canal to the scrotum The cord has layers corresponding to the tunics of the testis It contains the vas deferens the blood vessels nerves and lymphatics of the testes and the epididymides

The *internal spermatic artery* of the testis arises from the aorta just below the renal artery Lesser vascular branches are derived from the *deferential artery* a fine branch of the inferior vesical artery and the cremasteric or external spermatic artery a branch of the inferior epigastric The importance of the triple blood supply to the testes rests in the fact that function may be maintained if any one of these vessels is patent though the other two are sacrificed in surgical procedures and in wounds The *spermatic veins* have considerable clinical importance because of the frequency of *varicocele* They form the *pampiniform plexus* as a part of the spermatic cord Dilatation and tortuosity of these veins produces the sensation of a bag of worms familiarly recognized as the varicocele

The Seminal Vesicles—The seminal vesicles secrete a clear gelatinous material that forms part of the seminal fluid They may also function as reservoirs for sperm Each sac lies alongside and lateral to its respective vas It has a length of approximately 2 inches and is in close relationship to ureters bladder and prostate Each vesicle has a main canal containing many convolutions and diverticula This canal unites with the ampulla of the vas to form the ejaculatory duct

The Ejaculatory Ducts—The ejaculatory ducts are the common ducts formed by the seminal vesicles and the vas deferens They traverse the prostate gland elevating the urethral mucosa to form the *urethral crest* or *verumontanum* Here the ejaculatory ducts discharge their contents into the posterior urethra The prostatic ducts open lateral to the urethral crest

The Accessory Reproductive Glands—The mucous structures of Littre the bulbo-urethral glands of Cowper and the extremely important prostate gland are accessory reproductive structures

Littre s Glands occupy a position in the upper dorsal and lateral surfaces of the urethra Bacteria may be retained in their acini and function as foci of reinfection The *bulbo urethral glands of Cowper* lie between the prostate and the bulb These glands form a common duct which penetrates the triangular ligament to open onto the ventral surface of the bulbous urethra They secrete a mucus rich in albumin which is discharged into the urethra at the time of ejaculation The main clinical importance of the Cowper glands is their tendency to harbor infection particularly *gonorrhea*

The *prostate gland* lies at the neck of the bladder It is transpierced by the urethra and the ejaculatory ducts The prostatic gland is five lobed The two lateral lobes make up the bulk of the gland The median anterior and posterior lobes are relatively small All are enclosed in a fibrous capsule and make up a mass that is firm and elastic The prostate varies considerably in size The average dimensions are 3 4 cm in length 4 4 cm in width and 2 6 cm in thickness

The prostate forms an external secretion which is added to the seminal fluid at the time of ejaculation Its function remains unknown Its chief significance is related to the *urinary obstruction* that accompanies prostate *hyperplasia hypertrophy* and *neoplasm*

NORMAL PHYSIOLOGY

The physiology of the male reproductive system is concerned with puberty spermatogenesis the production of semen and androgen sexual intercourse and the male climacteric

Puberty—During the twelfth or thirteenth year the changes of puberty appear in association with a marked augmentation in the excretion of androgen in the body fluids The external genitalia increase in size and erections and 'wet dreams are experienced The lad becomes girl conscious and experiences characteristic emotional and vasomotor instability Secondary sex characteristics appear particularly relative to hair distribution (p 2413) The prostate increases in size the voice cracks and then permanently assumes its lower pitch fat deposits diminish on the abdomen and thighs

amount is of no clinical importance At first the ejaculate is gelatinous in consistency but on exposure to air it liquefies in ten to thirty minutes The ejaculation of a liquid semen suggests an abnormality The color is greyish or opaque pus produces a yellowish tint while an admixture of blood results in a red or brown specimen The normal *p*H varies from 7.5 to 8 0 Sperm counts are made in the manner of red blood counts except that the diluent is made by adding 5 gm sodium bicarbonate and 1 cc formalin U S P to 100 cc of distilled water

Microscopic examination of semen reveals myriads of motile spermatozoa *In a normal sample 15 per cent may be motionless* (necrospermia) and an equal number appear sluggish The remainder should have a normal appearance or present some common physiologic variation such as pear shaped smaller or larger rounded heads or a remnant of cytoplasm about the head and neck as seen in immature forms Pathologic abnormalities include very large very small or double heads and large numbers of round immature spermatozoa

In addition to the spermatozoa semen contains other formed elements such as the spindle shaped Sertoli cells spermophages containing remnants of phagocyted sperm leukocytes spermine crystals and prostatic and lecithin corpuscles

The abnormalities noted in the semen include *oligospermia* a sign of decreased fertility *necrospermia* which indicate motionless sperm *azoospermia* in which there are no mature sperm and *aspermia* in which the ejaculate fails to reveal any of the sex gland elements

Androgen the Testicular Hormone—The interstitial cells of Leydig are the sources for the production of androgen The substance is necessary for the development and maintenance of the male accessory sexual apparatus It stimulates the development of secondary sexual characteristics and produces distant effects on muscle strength muscle mass and the growth and development of the skeleton It favors epiphyseal closure and alters the sebaceous secretion of the tegumentary system It influences the distribution of fat body water and electrolytes as described in more detail elsewhere (p 2404)

The hormone is produced from puberty to later middle life after which the male climacteric (p 2414) may be experienced After acting upon the various tissues it is excreted in the urine as androsterone and other cleavage products The level of urinary androgen excretion may indicate the functional state of the testicular tissue though excessive androgen excretion is often of adrenal cortical origin

Sexual Intercourse—The male participation in the act of sexual intercourse consists of phases of erection orgasm with ejaculation and detumescence Unlike the frigid female who may be quite fertile the impotent male is not capable of impregnating his sexual partner That sterility does not interfere with libido or intercourse is illustrated by potency following vasectomy done as a preliminary to *prostatectomy* (p 2407) and as the alleged rejuvenation operation of *Steinach* (p 2407)

Erection—Erection is a reflex act of great complexity that may be of psychogenic or local origin The phenomenon arises as the result of a mechanical engorgement of the corpora cavernosa which are encased in a sheath of elastic fibers (Buck s fascia) With the first distention of the

The motility of the cells is dependent upon the whiplike motion of the tail Motility is a sign of vitality and should persist for several hours The normal semen contains 75 to 150 million spermatozoa per cubic centimeter

Disturbances of spermatogenesis are discussed with *hypogonadism* (p 2412) and *sterility* (p 2418) and often have no relationship to *virility*

Semen—Semen is a mixture of the secretions of the testicles the epididymides the seminal vesicles the prostate gland and Cowper s and Littre s glands It consists of a liquid substratum in which are suspended the spermatozoa and other formed elements

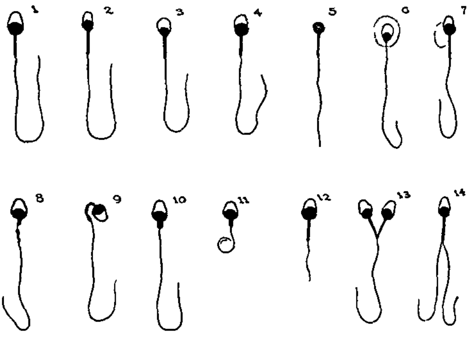


Fig 576—Spermatozoa showing various morphologic abnormalities 1 Normal spermatozoon for comparison 2 narrow head 3 tapering head 4 roughened head membrane 5 small head solidly staining 6 immature head with cytoplasm not cast off body lacking 7 immature head with cytoplasm partially cast off 8 irregular body 9 bent body 10 short thick body 11 short body curled tail 12 rudimentary tail 13 double head, double body 14 double tail *

For examination of semen a fresh specimen should be obtained by masturbation or coitus interruptus Specimens obtained by puncture of the testis or epididymis are not comparable to the normal ejaculate which should be placed in a clean wide mouthed ointment jar or beaker Condom and cotton plug specimens are of little value since the sperm are easily affected by chemical and mechanical factors The specimen should be kept at room temperature (20° C) A higher temperature even at 37° C impairs the vitality of the cells On the other hand raw semen kept on ice for seven days retains its power of fertilization

The usual amount of semen produced in a single ejaculation approximates 3 to 6 cc A small amount may be related to sterility but a larger

* After S R Meaker Human Sterility The Williams and Wilkins Co Herman The Practice of Urology

amount is of no clinical importance At first the ejaculate is gelatinous in consistency but on exposure to air it liquefies in ten to thirty minutes The ejaculation of a *liquid semen suggests* an abnormality The color is greyish or opaque pus produces a yellowish tint while an admixture of blood results in a red or brown specimen The normal pH varies from 7 5 to 8 0 Sperm counts are made in the manner of red blood counts except that the diluent is made by adding 5 gm sodium bicarbonate and 1 cc formalin U.S P to 100 cc of distilled water

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penis the elastic sheaths constrict the efferent vein while the dartos of the scrotum compresses the superficial channels that run in the loose layers of the connective tissue The occlusion of the venous outflow is abetted by an increase in arterial flow The pathway of erection is through the involuntary nervous system the hypogastric plexus supplying filaments that correspond to the nervi erigentes of animals

The disturbances of erection include *impotence* (p 2409), *priapism* (p 2411) and *chordee* (p 2411)

Ejaculation—The male climax or orgasm is manifested by the ejaculation of seminal fluid The performance is accomplished by an exceedingly complex coordination of the muscles of the reproductive system it is accompanied by secretory stimulation of the accessory reproductive glands and of the epithelium of the seminal tract The mucous membrane of the excretory system adds a semifluid gelatinous material which acts as a lubricant and a menstruum for the spermatozoa The seminal vesicles contribute a clear gelatinous fluid and the prostate gland adds a thin milky secretion which is alkaline and has a characteristic musty odor The latter may act as a food or stimulant for the sperm cells The secretion of the bulbo urethral gland of Cowper is a glairy mucoid substance which is protein in composition

The interposition of the seminal vesicles along the excretory seminal tract suggests that they function as a reservoir for the spermatozoa Their capacity more or less equals the amount of seminal fluid in each ejaculate It is quite conceivable that distention arouses the sexual instinct of the male who is then exposed to the hazard of mistaking his increased *intraseminal pressure for the tenderer sensation of love*

The principal disturbance of ejaculation is the *premature emission* which results in failure to deposit the seminal fluid intravaginally and also hinders the artistry of the act of sexual intercourse The span of time that elapses between erection and ejaculation is a variable and is capable of voluntary control Those who pursue the art of love attempt to hold the erection and repress ejaculation until the onset of the female orgasm so that the two partners experience the climax at a single moment Much of sexual dissatisfaction by the woman results from imperfections in timing The male is usually more rapid in his reactions and when his ejaculation occurs prematurely with reference to the female the latter is often ungratified restless and in danger of developing frigidity or even repulsion to coitus

Detumescence—Detumescence occurs immediately after ejaculation and is followed by a variable period of latency relative to erection In younger blades the interval may be measured in minutes whereas old campaigners require days or even weeks for recovery Failure of detumescence results in *priapism* (p 2411)

METHODS OF EXAMINATION

The practitioner conducts a routine physical examination of the male reproductive organs by inspecting and palpation (p 3634) of the external genitals and by rectal exploration of the posterior surface of the prostate and the region of the vesicles

Special Laboratory Tests.—On indication special tests provide particu

lar information The site of an infection is often revealed by the inspection of the urinary sediment obtained in *two or three glass test* (p 3666) *urethral discharges* are stained and cultured before and after pro tatic massage, for the demonstration of gonococci (p 50) exudates from ul cerating lesions and the moist dermatoses are subjected to *dark field microscopy* and are *stained* by the Pappenheim method (p 49) for *H ducreyi* by the Wright or Giemsa method for demonstration of the intracellular Donovan bodies (p 475) of granuloma inguinale *Serologic tests are performed for syphilis (p 337) and skin tests* are done by the Frei method (p 473) in lymphopathia venereum and with Ducrey antigen in chancroidal infection *Semen* is examined by microscopy in the inves tigation of sterility (p 2400) The scrotum is *transilluminated* (p 3652) to detect the physical state of a swelling and *palpation* discloses the varico cele (p 2433)

Specialist Examinations—The consultant urologist deals with the more intricate examinations of the male reproductive system *Aspiration of the testis* throws light on the function of spermatogenesis and the hi t l [illegible] *of a tumor or a chronic inflammatory process injections of opaque* [illegible] *nal* into the seminal vesicles enable the radiologist to obtain visuali [illegible] of these deeply situated structures *biopsy* of local lesions is of import [illegible] in the chronic inflammatory processes particularly syphilis and t [illegible] losis and for the early diagnosis of malignancy studies of blood *a*[illegible] *phatase* reveal prostatic metastases urinary excretions of *gon*[illegible] *androgen* and *estrogen* aid in the diagnosis and management [illegible] testicular tumors (p 2441)

METHODS OF TREATMENT

The accessibility of the male genitalia has given great impet[illegible] to local forms of therapy by instrumental and non instrumental m[illegible]lities Of greater recent interest and significance have been the phenomenal results obtained by systemic chemotherapy and by glandular products in the alleviation of disorders of the male reproductive system

LOCAL TREATMENT

Methods of local therapy are readily applied to the urethra and the male reproductive organs The testes are supported by a jock strap or suspensory condoms are employed for protection against the venereal dis eases and as contraceptives the prostate gland may be massaged by rec tum and heat is applied by sitz baths rectal irrigations or pelvic d atherm[illegible] using a rectal electrode

The venereal prophylactics (p 3122) *are applied to the penis and* injected within the urethra *inunctions* of androgen have more erotic ap peal than scientific value and the same may be said for the locally applied aphrodisiacs *Irradiation* of the testis is an effectual and simple method of producing castration It is of particular value in the treatment of malignancies and in the sterilization of the criminally insane and men tally defective

SYSTEMIC TREATMENT

The efficacy of systemic therapy particularly in the infections has stressed the futility and *even harmfulness of most local* topical and in

strumental measures The sulfonamides prevent and usually cure gonorrhea chancroid granuloma inguinale and lymphopathia venereum penicillin excels sulfonamide in the treatment of gonorrhea and holds great promise in the control of syphilis antimony may be of additional value in granuloma inguinale Streptomycin is a specific in coliform invasions

The systemic aphrodisiac and anaphrodisiac drugs enjoy reputations for efficacy that are more psychogenic than pharmacologic It takes something more potent than saltpeter to mute the biological urge and more than celery tonic' to revive it once it has fallen into its declining phase.

ANDROGEN

The Androgenic Drugs—The physiological index of testicular hormone activity is its ability to stimulate the growth of the capon s comb and the accessory sex organs (prostate seminal vesicles) of the spayed rat All compounds possessing this property are termed androgens

Several chemical forms of the testicular hormone have been isolated The first compound to be obtained was *androsterone* a steroid extracted from male urine Subsequently extracts of the testes (bull) were shown to be more active than androsterone and a testicular principle, *testosterone* was isolated The only chemical difference between androsterone and testosterone is in the position of one hydroxyl (OH) group and one double bond on the steroid skeleton Testosterone is ten times more active than androsterone and is regarded as the true testicular hormone

Testosterone is rapidly excreted and destroyed when given by mouth and must be administered parenterally *Methyl testosterone* a synthetic androgen is less active than is testosterone by injection but is more effective orally *Ethinyl testosterone* is a synthetic steroid having androgenic estrogenic and progestational properties (see progesterone) It is effective when given orally

About sixty pure substances with androgenic activity have been isolated In addition to testes and male urine androgens have been obtained from the adrenal cortex adrenal cortical tumors female urine and pregnancy urine and have also been synthesized from sterols (cholesterol)

Unitage and Bioassay—One hundred micrograms (gamma) of crystalline testosterone represent the *international unit* of androgenic activity The chief method of measuring the activity of an androgen involves the study of its growth promoting effects on the capon s comb The extract to be tested is injected intramuscularly or applied directly to the comb The growth induced is measured directly and compared to that obtained from crystalline testosterone An alternate method to denote androgenic potency uses the increase in weight of the prostate and seminal vesicles of a castrated rat or mouse Both methods are subject to wide variations depending on experimental factors (species age season) Crystalline androgens are dispensed by weight the proper dosage being determined by clinical trial

Administration—All of the possible modes of administration of the steroid hormones may be employed with respect to testosterone the chief androgen used therapeutically *Intramuscular injections* of testosterone or its propionic esters in oil are the methods of choice *Testosterone ointments* afford a simple but tedious method of applying androgen percutaneously

Pellets of crystalline testosterone or its esters may be implanted subcutaneously with satisfactory result

Testosterone is only one twentieth as active *orally* as parenterally Methyl testosterone is inferior to testosterone propionate when given by injection but it is superior to testosterone and its esters by mouth The oral activity of this compound is equal to two fifths of its activity in injection

Physiology —The testicular hormone is necessary for the development and maintenance of the sexual apparatus (penis prostate seminal vesicles epididymis and Cowper s glands) and the secondary sexual characteristics of the male

The manifold effects of androgen are indicated by a brief consideration of *castration* If the gonads are removed before puberty the accessory sex organs fail to develop and the typical sexual characteristics fail to appear Ossification of the epiphyses of the long bones is retarded the limbs are long in relation to the trunk and obesity is common Castration in adult males results in a regression of the beard a tendency to a high pitched voice muscle flabbiness and a loss of muscle strength Weakness lack of endurance and hypotension are common The external genitalia atrophy and fat is deposited on the trunk

The administration of testicular hormone to a hypogonad male results in enlargement of the penis scrotum prostate and seminal vesicles stimulation of pubic and axillary hair as well as general hirsuties deepening of the voice and a coarsening of the skin texture There is a decreased urinary excretion of water sodium chloride potassium phosphorus and nitrogen There is an increase in body weight largely due to the addition of true cellular mass There is an increase in muscle mass and muscle strength

Many of the above effects have been observed in females to whom testicular hormone is administered because of its ability to counteract the effect of *estrogens*

The continued administration of testes hormone inhibits the activity of the anterior lobe of the pituitary as do the estrogens with a resultant decrease in the formation of *gonadotropic hormone* and secondary suppression of gonadal activity particularly spermatogenesis Increases in the basal metabolic rate have been noted where large doses are used

Therapeutics *Testicular Deficiency Hypogonadism*—The chief indication for androgen therapy is severe testicular deficiency resulting from failure of gonadal development or bilateral orchidectomy The average patient requires 25 mg of testosterone propionate in oil injected intramuscularly six or seven times weekly Oral administration is associated with clinical benefit when large amounts of methyl testosterone (25 to 100 mg daily) are used Within a short period after the institution of replacement therapy there is an increase in libido and sexual power The genitalia grow in size and erectile ability is enhanced Growth of sexual hair and changes in the skin are rapid and there is prompt increase in muscle strength Regressive changes occur on cessation of the medication

Since it is difficult to distinguish between delayed sexual maturation and true hypogonadism the management of young boys with signs of testicular deficiency calls for some caution in the use of androgens There may be harm in the administration of these preparations to young boys

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is discontinued In many cases there is a marked improvement in the functional bleeding (p 2557)

A dose of testosterone propionate of 150 to 500 mg in a single cycle starting not later than the sixth day of the cycle may afford complete relief from *dysmenorrhea* (p 2561)

The administration of testosterone propionate in doses of 25 to 50 mg three times weekly provides an effective means of alleviating the symptoms of the *menopause* The effect is associated with a decrease in the urinary gonadotropic hormone titer and the production of a normal estrus smear This therapy has been recommended in those cases that respond poorly to estrogens or in those in whom bleeding is excessive Since it is not physiological it is not a method of choice and should be used cautiously

Anticarcinogenesis—Injections and transplants of androgen have been suggested in the treatment of carcinoma of the breast with and without metastases An occasional brilliant result is observed though by and large the results are disappointing (p 2581)

SURGICAL THERAPY

Surgery of the male reproductive organs is accomplished by many simple procedures that are often performed These include *circumcision* (p 3936) *aspiration and injection of the hydrocele* (p 3937) *varicocelectomy* (p 3939) *ligation of the vas and vasectomy* (p 3938) *transurethral prostatectomy* (p 2448) and prostatectomy by *suprapubic* or *perineal* approaches

Less frequent operations include *amputation of the penis* for malignancy *orchidectomy* for uncontrollable infection unilateral malignancy of the gonad or metastatic carcinosis of prostatic origin *seminal vesiculectomy* for persistence of infection and plastic procedures performed for the *correction of conditions associated with congenital abnormalities and maldescent of the testicle*

Sterilization is most easily effected by vasectomy or roentgentherapy The former also constitutes the Steinach operation for rejuvenation one of the more recent exploitations of a gullible public

since large amounts of androgens may cause an early arrest of skeletal growth by bringing about a premature closure of the epiphyses

The use of androgens has its advocates in the treatment of the symptoms arising from the aging of testicular function a state termed the male climacteric The administration of testosterone is said to alleviate the vasomotor symptoms the melancholia and the muscle weakness that are common to this state Subjective benefit may be obtained without any manifestation of sexual stimulation See also p 2417

Prostatic Hypertrophy—The treatment of prostatic hypertrophy with androgens is largely empirical The results are not yet conclusive Usually no perceptible change in the size of the prostate is noted although the patient may note a reduction in frequency, decreased nocturia and a general feeling of well being

Bilateral Intra abdominal Cryptorchidism—In bilateral undescended testes when there has been no response to chorionic gonadotropin androgen therapy merits trial

Cushing s Syndrome—According to Albright the basic defect in Cushing s syndrome is a hyperfunction of the adrenal cortex which results in the overproduction of sugar from protein (see adrenal cortex) a decreased glucose tolerance and a decreased availability of amino acids for building proteins The clinical manifestations of the syndrome result from the protein deficiency produced by the excessive protein catabolism *i e* the muscle weakness the thin skin easy bruisability the osteoporosis etc The administration of testosterone to patients with Cushing s syndrome caused nitrogen and phosphorus retention according to the ratio found in protein a positive calcium balance and a delayed rise in serum phosphatase The patients noted increases in strength and a lessening of fatigue Twenty five to 50 mg of testosterone propionate daily were necessary to produce these effects This form of treatment is interesting but is apparently without value in many cases It is difficult to see how the administration of additional androgen should benefit a predominantly androgenic syndrome

Dwarfism—Because of its nitrogen retaining or growth hormone like effects testosterone has been used in the treatment of male symmetrical dwarfs (ateliotic)

Androgen Therapy in the Female—The androgens have a number of interesting actions in the human female They suppress the formation of the anterior pituitary gonadotropic factor which leads to a depression of ovarian function They antagonize the action of estrogen and progesterone on the uterine mucosa producing atrophy of the endometrium The action on the vaginal smear is variable the effects being either positive or negative The breast tissue may be depressed or stimulated As untoward reactions patients often note hirsuties hoarseness atrophic vaginitis clitoral enlargement a rapid weight gain an increase in libido and acne vulgaris

Androgens have been used therapeutically in the treatment of menstrual disorders and in the management of the menopause

The administration of 300 to 400 mg of testosterone propionate during the menstrual cycle in divided doses provides effective control of *profuse menorrhagia* and *metrorrhagia* Temporary amenorrhea may be continued for long periods with a return of the normal ovulatory cycle when treatment

IMPOTENCE

Impotence may be relative or absolute It arises from psychogenic local neurogenic glandular and systemic causes

DIFFERENTIAL DIAGNOSIS OF

Male Impotence

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Psychogenic	See p 2439
Physiologic	With senescence
Generalized Infection	All wasting diseases but particularly tabes dorsalis and general paresis Check blood and spinal fluid Wassermanns and gold curves (p 3659)
Metabolic	In states of cachexia from whatever cause but particularly with generalized arteriosclerosis and malignancies
Penile	Phimosis paraphimosis and balanoposthitis (p 2454) Hypospadias and epispadias (p 2886) Irritations and ulcerations whether infectious or malignant (p 2439) Make dark field examination (p 47) Get smears cultures and biopsy of local lesion (p 50)
Scrotal	Hydrocele Elephantiasis
Urethral	Acute and chronic anterior and posterior urethritis Get urethral discharge for smears and cultures (p 2430)
Testicular	Orchitis teratoma and neoplasms (p 2443) Epididymitis particularly tuberculous (p 2463) Consider aspiration or biopsy on suspicion of malignancy
Seminal	Inflammations and neoplasms of seminal vesicles and prostate (p 2445) Confirm by rectal examination and examination of urethral discharge after massage (p 50)
Neurogenic	Cord lesions such as transverse myelitis scleroses neoplasms and tabes Supplement neurological examination with examinations of cerebrospinal fluid (p 3734) Contrast radiography if indicated (p 3075) Consider exploratory laminectomy
Toxic	Resulting from alcoholism drug addiction and overdosage with sedatives and hypnotics
Endocrinopathies	Infantilism (p 2774) Eunuchism particularly that associated with anterior pituitary deficiencies (p 1169) Get x ray of sella turcica (p 1177) Congenital cretinism and adult myxedema with low B M R. Note therapeutic response to thyroid extract.
Physical and Chemical	Following irradiation and injuries resulting in atrophy of the testes

Etiology—The commonest cause for male impotence is the psychogenic modification of male participation in the act of copulation The obvious

CHAPTER 114

THE MALE REPRODUCTIVE SYSTEM: PATHOLOGIC PHYSIOLOGY

Disturbances of Reproductive Function and Sexuality
- Impotence
- Premature Ejaculation
- Coitus Interruptus
- Priapism
- Chordee
- Satyrism
- Chronic Masturbation
- Nocturnal Emission
- Homosexuality and Perversion

Hypogonadism
Hypergonadism
Dislocation of the Androgen-Estrogen Ratio
Sterility

The pathologic physiology of the male reproductive system may involve spermatogenesis, sexual intercourse, or the internal secretory economy. While there is a certain amount of interdependence between the sexual functions, they are by no means necessarily linked. Sterile men are often sexually adequate and apparently normal in their gonadal secretory phenomena; the impotent are often capable of normal spermatogenesis and rarely present the features of hypogonadism.

DISTURBANCES OF REPRODUCTIVE FUNCTION AND SEXUALITY

Absence of sperm from the semen (*azoospermia* or *aspermia*) may be secondary to absence of the gonadotropic factor in the secretion of the anterior lobe of the pituitary gland, or it may result from atrophy, destruction or removal of the testes. In either instance, the patient is sterile and suffers from hypogonadism, though there is not necessarily a significant disturbance in sexuality.

Lesser degrees of disturbances of spermatogenesis result in *oligospermia* and *necrospermia*. In the first instance there are few spermatozoa present in the semen, and in the latter instance, they are immotile (p. 2401).

Abnormalities of male sexuality include *impotence* or failure to produce erection; *premature ejaculation*, the orgasm occurring before the vagina is entered; *coitus interruptus* or withdrawal of the penis from the vagina before ejaculation occurs; *priapism* or *chordee*, due to failure of detumescence; *satyrism*, in which the sexual appetite is not appeased after repeated erections and ejaculation; *chronic masturbation*; *nocturnal emissions*; and *homosexuality* by pederasty (per anus, using boys), sodomy (per anus, using adult males) or fellatio (per oram).

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traumas include fear of infection or impregnation awkwardness due to inexperience or the necessary furtiveness and conscience reactions inherent in illicit relationships

Sometimes the failure is due to more deeply located psychogenic conditionings Some men are virile conjugally but impotent extramaritally and the contrary is also observed Others require symbols and fetishes to assist erection while some are impeded by associations Illustrative of the former are the erotic influences of diaphanous garments or nudity of perfumes and odors colors and situations By contrast "blocks may be established by sounds noises locales or expressions particularly in the hypersensitive One of our prize examples involved a neurotic who compelled his wife to have coitus on the floor since he found himself impotent in bed as the result of the noises of the bedding These reminded him of similar sounds he had heard as a boy when he was outraged by the thought of his father compelling his mother to have intercourse in an adjoining room

Impotence is not uncommon on the wedding trip The prolonged sexual congestion and the heinous attempts of the wedding guests to get the groom tight combine to produce a nuptial fiasco that may terminate tragically Many of the depressive psychoses are associated with impotence and often the sexual debility is accounted a causative factor in the nervous breakdown

The relationship of *age* to impotence is variable Many octogenarians are still able to function sexually while less virile men may develop impotence earlier in life suggesting a male climacteric

Treatment—The treatment of male impotence consists in the control or removal of local and systemic etiologic factors In the functional states particularly those of psychogenic origin a simple explanation of the biological facts may produce a happy result *Aphrodisiacs* (p 3897) local and systemic are of no particular value the local uses of contraptions of one type or another and of ointments containing counterirritants such as cantharis are greatly to be condemned *yohimbin* has been abandoned as a useless and expensive remedy *ligation of the vas* (p 2407) as practiced by Steinach is obviously a method of psychotherapy

Local applications of androgen and injections of *androgen* (p 2401) and/or gonadotropin provide results that are by no means consistent Accompanied by psychotherapy they may produce the desired effect large doses of androgen may inhibit spermatogenesis

PREMATURE EJACULATION

Premature ejaculation is a functional condition that is usually due to inexperience excessive libido or a combination of both It is a frequent cause of sexual disturbances of the female who cannot under these circumstances be normally gratified With patience and training premature ejaculation should be controlled Mechanical devices and drug therapy are best avoided

COITUS INTERRUPTUS

Coitus interruptus or withdrawal constitutes a stupid and harmful attempt at contraception The practice should never be tolerated If con

traception is advisable other methods (p 2502) should be suggested With drawal *results in diminished gratification for* both sexual partners and does not prevent the intravaginal deposition of semen

PRIAPISM

Priapism is a pathologic state in which the penis continues to be erect without orgasm and without detumescence *It is not necessarily* accom panied by sexual desire and may produce intense discomfort and pain In infancy priapism is probably due to a local disorder such as a tight phimosis a balanitis or irritation from circumcision In adult life priapism is apt to be caused by enlargement or local inflammation of the prostate gland It accompanies spinal cord injuries or infiltrations by tumor masses or leukemic cells

The pain of priapism is relieved by cold applications although opiates may be required *With thrombosis of the corpora cavernosa incision and* the evacuation of the clot may prevent gangrene of the penis Reflex lesions may be ameliorated by caudal anesthesia (p 3922)

CHORDEE

Chordee is a variety of priapism which occurs as the result of a gon orrheal infection It is intensely painful and *treatment* is directed at the relief of the local inflammation

SATYRISM

Satyrism as opposed to priapism is the failure to appease the sexual appetite after repeated erection and orgasm It is prone to occur in indi viduals who have suffered from prolonged sexual continence (sailors or explorers) and in elderly men with senile psychoses and involutional states It accompanies the adrenal tumors characterized by virilism (p 1268) *and may occur in the agitated types of psychosis (p 1364) particularly* where there are expansive views (p 1369)

Treatment with the alleged anaphrodisiacs such as saltpeter and bro mides is a futile gesture but hydrotherapy in a continuous bath may be of temporary efficacy

CHRONIC MASTURBATION

Occasional masturbation is virtually universal in the male It is pro *ductive of no physical or physiologic disturbance provided that the* sub ject is not given a guilt complex or precipitated into an acute or chronic anxiety as the result of the misinformed zeal of the reformer The great hazard of masturbation is the difficulty with which the addict adjusts himself to normal intercourse This explanation is most effective in per suading the individual to exert self control in abolishing or decreasing the practice

Chronic masturbation is of frequent occurrence in the sexually conti nent in the neurotic and in the psychotic The use of anaphrodisiacs accomplishes nothing Gentle persuasive *psychotherapy* is most helpful just as condemnation and threats furnish the greatest trauma

NOCTURNAL EMISSION

The nocturnal emission or 'wet dream' is a normal phenomenon in those who do not have regular sexual intercourse It is neither weakening nor debilitating and requires no treatment other than reassurance of its normality

HOMOSEXUALITY AND PERVERSION

Male homosexuality and perversion are becoming increasing problems in clinical practice The basis of most homosexuality is a characterologic disorder or a more profound psychic disturbance although recent studies indicating a dislocation of the androgen estrogen ratio (p 2418) suggest a biochemical causation for the disturbance, under which circumstance corrective therapy may become available

The male homosexual may play the masculine or feminine role in the relationship In *pederasty* as practiced in ancient Greece and described by Horace young boys are used in the receptive role employing the anus *Sodomy* whose name is derived from the Biblical village of Sodom (Genesis XIII XIV XIX) refers to intercourse per anum with females though it may apply to either sex and fellatio involves oral perversion It is not uncommon to meet with bi sexual individuals who marry and have children but engage in extramarital homosexuality

The complicated problems of homosexuality are best referred to the psychiatrist with small hope for any alteration of the situation Most alarming may be the homosexual panics usually clouded and disguised in many forms The latent homosexuality threatens the afflicted whose reactions are most devious and intense

Attempted therapeutic programs using threats moralization and rationalization are ill advised since they may precipitate a suicidal effort Psychoanalysis which would appear to hold greatest promise of relief has in our experience been disappointing

HYPOGONADISM

Loss or diminution of testicular function produces fundamental alterations in the sexual and somatic spheres The resultant clinical manifestations vary according to the degree of glandular deficiency the age of the *individual at the time of the disturbance and the glandular* mechanism that is involved With complete loss of testicular function the state of *eunuchism* exists while *eunuchoidism* results from a partial gonadal deficiency The symptoms vary according to the age of the patient and may be *prepuberal post puberal* or if they arise at the time of the normal decrescence *climacteric* Finally the clinical picture is dominated by the mechanism of the deficiency In primary hypogonadism due to an intrinsic disorder of the parenchyma of the testes the syndrome is not complicated by the additional features of secondary hypogonadism in which there are the superimposed disturbances of the anterior pituitary gland (p 1169)

Etiology—*Primary hypogonadism* is usually due to a congenital anomaly infection injury or toxic influence involving the testes *Congenital absence* of both testes is very rarely observed and unilateral absence is associated with sufficient hypertrophy of the intact organ to produce an

adequate level of gonadal function The commonest congenital cause for hypogonadism is *cryptorchidism* (p 2423) in which the testes remain in the abdominal cavity or the inguinal canal

Of the *infectious causes* of primary hypogonadism *epidemic parotitis* (mumps) is the most commonly observed resulting in extensive fibrosis and atrophy of the gonads and constituting one of the principal causes of male sterility *Gonorrhea* is occasionally complicated by an extensive bilateral orchitis and multiple abscess formation Less often the infectious destruction is due to *syphilis* or *tuberculosis*

Toxic influences are capable of irreparable testicular injury Atrophy may be seen as a manifestation of *lead poisoning* (p 762) *chronic alcoholism* (p 3851) or prolonged exposure to *roentgen ray* (p 3796) Hypogonadism also results from endogenous metabolic causation and is seen in *cirrhosis of the liver* (p 1969) *hemochromatosis* (p 1976) and *adrenal cortical deficiency* (p 1271)

Traumatic and surgical *castrations* are experienced Although the free mobility and the suspended position of the male gonads tend to protect them from injury they may be avulsed in industrial accidents injured in accident by impalement or wounded from projectiles in war It is said that certain Asiatic and Eastern European religious sects employ castration as part of their ritual Surgical castrations are performed therapeutically for extensive gonadal infection in the presence of *bilateral malignant neoplasm* of the testis and as a preventive measure with metastasizing carcinoma of the prostate gland

Secondary hypogonadism results from the failure of the interstitial cells to elaborate androgen when the stimulus of the gonadotropic hormone of the anterior pituitary gland is absent Hence eunuchism and eunuchoidism are associated with the *anterior pituitary deficiencies neoplasms* and *functional disorders* Other endocrine diseases that may produce secondary hypogonadism include diabetes mellitus adrenal cortical insufficiency and severe degrees of myxedema or hyperthyroidism

Clinical Manifestations—The clinical manifestations of hypogonadism differ in degree for the most part depending upon the age of the patient at their onset Prepuberal postpuberal and climacteric syndromes are described

Prepuberal Eunuchism—Prepuberal castration has far reaching effects on the growth and development of the body as a whole The normal growth changes in the accessory sex organs (prostate gland seminal vesicles and penis) and the development of masculine sexual characteristics fail to take place The penis remains small and infantile the testes are atrophic and may be undescended (cryptorchidism) the prostate is not palpable the facial and body hairs are scant and the pubic hair is absent or of female distribution The mammary glands are often enlarged (gynecomastia) and there may be a marked degree of girdle obesity there is an excessive growth of the long bones due to the failure of the epiphyseal synarthroses to close

These changes combine to produce the typical habitus of the eunuch marked by long extremities and a short trunk with narrow chest and shoulders Additional characteristics of the immature castrate are the high pitched voice the small delicate larynx lack of prominence of the thy

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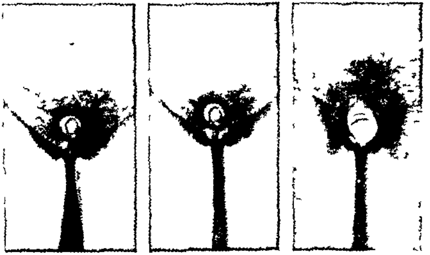
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urinary excretion of androgen is often decreased and the output of the pituitary gonadotropic factor is compensatorily increased

Diagnosis—The diagnosis of prepuberal hypogonadism offers little difficulty since the hypoplasia of the external genitals is obvious and there is a notable absence of the normal secondary sexual characteristics In chubby youngsters the penis may be imbedded in suprapubic fat but the normal organ appears when the tissues are separated With postpuberal hypogonadism and the male climacteric the diagnosis is of lesser im-



A B C

Fig 5 7—Eunuchoidism (bilateral intra abdominal cryptorchidism) in a man aged twenty nine showing no effect from treatment with chorionic gonadotropin and a marked effect with testosterone propionate

A July 22 1937 before treatment Patient had extremely small genitalia and the prostate was not palpable He was effeminate smooth skinned had no beard and no hair on his abdomen or extremities There was a small amount of pubic hair His voice was high pitched and he had a marked inferiority complex

B February 2 1939 after 1 024 000 rat units of A P L Practically no change in genitalia Prostate not palpable He had gained 2½ kg

C September 26 1939 after 8800 mg of Oreton Marked growth of genitalia Prostate 3 cm in diameter Increased growth of hair on body and development of a more normal body contour in spite of a gain of 9 0 kg The patient grew a beard requiring him to shave every other day His voice became masculine and he became much more energetic and aggressive

portance It is presumptive and often rests on the results of therapeutic tests

The most important problem in hypogonadism is that of differentiating between the primary and secondary varieties An attempt is made to ascertain whether or not a pituitary or suprasellar neoplasm is present by radiography of the sella turcica (p 1177) examinations of the visual field (p 1158) and studies of the urinary excretion of pituitary and sex hormones A high titer of pituitary gonadotropic factor indicates a primary testicular failure whereas an absence of hormone favors the view that the hypogonadism results from pituitary insufficiency

W O Thompson Cecil Textbook of Medicine.

roid cartilage (Adam s apple) smooth skin and lack of cutaneous pig mentation or tanning on exposure to sunlight The muscles are small and poorly developed, with diminished power There is a characteristic lack of energy, aggressiveness or endurance the individual is shy effeminate and emotionally unstable As a rule sexual desire is at a low ebb erections are feeble and infrequent, and the semen is of low viscosity and contains few or no spermatozoa

Postpuberal Eunuchism—Once normal puberty has taken place castration has little effect on skeletal growth and the secondary sexual characteristics already present persist with but slight change The complexion becomes pale and pasty due to a decrease in cutaneous blood flow and a regression of normal cutaneous pigmentation The external genitals undergo atrophic changes with a decrease in the size of the penis prostate and seminal vesicles but never reach the stage of underdevelopment seen in the prepuberal castrate The pubic axillary and facial hair becomes sparse the beard regresses and shaving is rarely necessary the voice elevates in pitch but remains masculine and the muscles become flabby and diminished in size and power These changes are most marked in the chest and extremities producing a feminine type of torso there is a tendency to obesity with the appearance of fat deposits around the mammary regions abdomen and mons pubis

The effects on the psychosexual sphere vary widely In some individuals sexual indifference is complete while in others sexual libido and the power of erection are undiminished The ability to copulate may be retained for years and considerable satisfaction derived from intercourse The more severely afflicted complain of nervous phenomena such as headache vasomotor instability (flushes and sweats) impaired mental power depression lack of ambition and marked emotional swings

The Male Climacteric—After the age of twenty five testicular function begins slowly to diminish and finally wanes between the ages of fifty five and sixty five The occurrence of impotence before fifty five is not uncommon but on the other hand sexual vigor and fertility are sometimes found to be present in men over eighty In most men the endocrine changes incidental to decreasing testicular function are well tolerated and cause little subjective disturbance Symptoms of the male climacteric are sometimes encountered however analogous to the menopausal syndrome of the female

The onset of the male climacteric is usually slowly progressive The principal manifestations are subjective They include sweats hot flashes paresthesias which are most likely of vasomotor origin emotional instability undue mental and physical fatigue and lack of interest in business and social life Angina pectoris may be encountered Depressions are common and may precipitate or provoke a manic depressive or involutional *psychosis*

In the sexual sphere potency is usually lost erections are weak and unsatisfactory and there may be no recognizable orgasm In some individuals the decreasing virility is associated with an unhealthy eroticism resulting in abnormal practices and social difficulties

The chief objective finding is benign hypertrophy of the prostate gland (p 2445) which is not a specific feature of the climacteric picture The

The *favorable effects* of treatment include the gradual appearance of the sexual characteristics of the adult male increase in libido the occurrence of erection and emissions a marked increase in appetite and body weight associated with greater size firmness and strength of the skeletal musculature augmented vigor and stamina a lesser tendency to fatigue loss of effeminate characteristics definite psychological improvement manifested by increased self confidence and a more aggressive masculine attitude an increase in the basal metabolic rate and a reduction in the urinary excretion of nitrogen inorganic phosphorus sulfate potassium sodium and creatine

The *untoward effects* of androgen therapy include priapism acne and edema of the ankles and face The last is due to the retention of sodium chloride and water

Gonadotropin Therapy in Secondary Hypogonadism—The treatment of secondary hypogonadism calls for a preliminary attempt to remedy the basic etiologic defect by *surgical removal of a pituitary or suprasellar tumor* (p 1177) or amelioration by *roentgen ray* If the etiologic process cannot be eliminated therapy with gonad stimulating hormone should be attempted The available substances (p 1154) include *anterior pituitary extracts chorionic gonadotropins of pregnant mare serum* and *chorionic gonadotropins of human pregnancy urine* The latter have been most extensively used particularly in patients with *cryptorchidism* (p 2423) or the *adiposogenital syndrome* (p 1268)

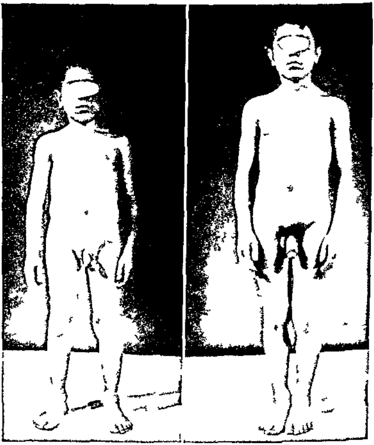
Androgen Therapy at the Male Climacteric—At the male climacteric treatment is indicated only in the presence of troublesome symptoms In mild examples reassurance and mild sedation are sufficient With severe distress hormonal substitution therapy permits a more gradual and satisfactory endocrine readjustment The preparations of choice are testosterone propionate intramuscularly and methyl testosterone orally High dosage is employed since in many patients the condition is unusually refractory to androgen therapy Tablets of methyl testosterone should be prescribed in 40 to 60 mg doses daily for two to three months with a later reduction to 20 mg If testosterone propionate is used it is customary to give three weekly injections of 25 mg for a period of six to eight weeks and then reduce the dose to 25 mg weekly

The evaluation of therapy is difficult since there is so great an element of psychotherapy associated with the use of a testicular extract Of the observable changes spermatogenesis (p 2399) contrary to expectation is usually inhibited Patients with *prostatic hypertrophy* report a lessening of dribbling frequency and nocturia but this is inconstant and inconsistent and certainly the gland feels no smaller and retention is not measurably decreased

Enthusiastic patients often report glowingly on their emotional and psychosexual improvement They relate a mental lift increased libido potency and virility and the data are often corroborated by the wife But once again these effects are neither constant nor consistent and the wary practitioner receives these testimonials with a mental reservation He promises nothing to his next patient who may as likely as not note little general effect and may even report diminished or absent sexual phenomena

Treatment —Patients with primary hypogonadism require substitution therapy with androgen, those whose difficulties are secondary to anterior pituitary deficiency may respond to gonadotropin (p 2417)

Androgen Therapy in Primary Hypogonadism —Androgen therapy may be attempted in the prepuberal castrate It is important to begin therapy before the twelfth year in order to promote normal growth and development and prevent the onset of the skeletal changes of eunuchism Large



A B

Fig 5/8 —Precocious sexual development and rapid skeletal growth during treatment with chorionic gonadotropin

A July 18 1936 before treatment age six years seven months Weight 19.5 Kg (43 pounds) Ht 114 6 cm (44¾ inches)

B July 24 1937 after eleven and one-half months of treatment with follutein (total dose 56 5,0 rat units) Weight 27 8 Kg (61¼ pounds) Ht 128 0 cm (50 inches)

weekly doses of testosterone propionate (25 to 100 mg) should be given by intramuscular injection or methyl testosterone may be administered orally in daily doses of 10 to 30 mg The initial aim is to produce the normal changes of puberty When therapy is well advanced the requirements become smaller and the doses should be reduced In some boys a weekly dose of 25 mg of testosterone propionate suffices but in conditions such as castration replacement therapy must be continued indefinitely

* Thompson and Heckel J.A.M.A, 110 1813, 1938

procreate may be presumed to exist if examination of the vaginal pool following intercourse reveals the presence of large numbers of motile spermatozoa of normal appearance

Imperfect Spermatogenesis—If there is a history of satisfactory erection penetration and ejaculation the causes for sterility of masculine ori

DIFFERENTIAL DIAGNOSIS OF

Male Infertility

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Impotence	See p 2409
Physiologic	Fatigue Cachexia and general debility Male climacteric (p 2414) Defects of spermatogenesis (p 2419) Try injections of androgen and gonadotropin (p 2416)
Congenital Anomalies	Absence of testes. Bilateral cryptorchidism Try treatment with gonadotropin and androgen (p 2416) Epispadias and hypospadias (p 2286) Consider plastic surgery Hermaphrodism (p 2531)
Physical and Chemical Injuries	Atrophy of testes due to trauma, irradiation alcoholism or lead poisoning Following castration, vasectomy or amputation of penis
Infection	Phimosis paraphimosis and balanoposthitis (p. 2454) Acute or chronic gonorrheal or nonspecific urethritis (p 23_8) Acute or chronic gonorrheal or nonspecific seminal vesiculitis or prostatitis (p 2467) Mumps orchitis (p 2464) Syphilitic orchitis (p 2 65) Genital tuberculosis (p 2463) Check smears and cultures (p 50) and blood Wassermann (p 337) Obtain aspirate or tissue for biopsy
Neoplasms	Particularly malignancies of penis, testes and prostate Get biopsy
Metabolic Disturbances	*Secondary hypogonadism, from deficiency o* gonadotropin in anterior pituitary disorders (p 1169) X ray sella turcica Note therapeutic response to gonadotropic hormone (p 1154) Myxedema with low B M.R. Try thyroid extract. Avitaminoses with specific response especially to vitamin E. Hemochromatosis with glycosuria, pigmentation and hepatic cirrhosis (p 1976) Adrenal cortical deficiency with pigmentation of mucosa and hypotension (p 1271)

gin are sought in factors that effect spermatogenesis and those that prevent or impede the deposition of sperm (obstructive sterility) Imperfect and absent spermatogenesis have been previously discussed (p 2399) They may be primarily testicular or secondary to disturbances of the gonadotropic hormone of the anterior pituitary gland The biological approach to therapy in either instance is through the injection of the *gonadotropic hormone* (p 1154) since injections of *androgen* paradoxically may impede spermatogenesis

A further disquieting aspect of androgen therapy in the patient with prostatic hypertrophy is the accepted observation of the effects of castration on metastatic *prostatic cancer* (p 2409) The possible carcinogenic influence of androgen on these malignancies lurks as a hazard to dampen *the ardor of the enthusiastic endocrinologist*

HYPERGONADISM (PUBERTAS PRAECOX, VIRILISM)

In contrast to the frequency of hypogonadism testicular hyperfunction is rarely observed In prepuberal stages pubertas praecox is occasionally encountered most often as the result of a tumor of the adrenal cortex (p 1278) or of the testis (p 2441) In these instances, there is an excessive secretion of androgen characterized by inordinate amounts of the hormone in the urine together with 17 ketosteroids Other but less usual causes for the disturbance include *thymoma* and *pinealoma* or the condition may arise as a sequel to *encephalitis*

Hypergonadism in the female results in the condition of *virilism* most often observed in certain types of anterior pituitary and adrenal cortical *neoplasms and in the arrhenoblastomas*

DISLOCATION OF THE ANDROGEN-ESTROGEN RATIO

Masculinity and femininity are apparently not pure physiological and biochemical conditions The male secretes demonstrable quantities of estrogen while androgen is present in the circulating fluids of the female Certainly the practitioner in his everyday practice is accustomed to seeing well integrated males with manifestations of feminization particularly in hair distribution and many relatively normal females have masculine features in their secondary sexual characteristics

Dislocation of the androgen estrogen ratio study of which is now in its *infancy may have important bearing upon many otherwise* obscure clinical problems Thus the condition of *acne vulgaris* may quite probably result from a relative excess of androgen in the blood whether in the male or female It is quite possible too that the problems of *homosexuality* may be dependent at least in part upon changes in the relative proportions of the gonadal hormones *Gynecomastia* the hypertrophy of the male breast which occurs in prepuberal hypogonadism of primary and secondary causa*tion may also be a manifestation of the dislocated ratio* (p 2578)

In the present state of knowledge it would take a very rash and en*thusiastic endocrinologist unmindful of other more profound* tissue effects to employ corrective therapy in the suspected imbalances Until the relationship of carcinogenesis to androgen and estrogen secretion is clearly defined we prefer to eschew gonadal therapy unless the indications are clearly defined and of significant intensity to justify the risk no matter how slight

STERILITY

Sterility is better regarded as a disorder of the marital couple rather than as a distinct defect of the male or female partner In consequence the material that follows dealing with male sterility is integrated with the discussion of *sterility* in the *female* (p 2492)

The fertile male possesses testes which are capable of producing mature sperm and a seminal tract which is unobstructed His capacity to

CHAPTER 115

THE MALE REPRODUCTIVE SYSTEM CONGENITAL ABNORMALITIES INJURIES AND MECHANICAL DISTURBANCES

CONGENITAL ANOMALIES

The important congenital malformations of the male reproductive system which are in the province of the practitioner are phimosis and cryptorchidism The remaining disturbances are more rarely encountered and require specialist technics for their correction

Less common than cryptorchidism are abnormalities of testicular numbers and size *Congenital absence* of one or both testes has been observed as well as the fusion of the intra abdominal gonads *Polyorchidism* (supernumerary testes) is an anomaly of great rarity *Congenital atrophy* of the testes is an obscure defect dependent in some instances on a primary glandular deficiency *Hypertrophy of the testis* is commonly a compensatory phenomenon following the absence or removal of one gonad None

Obstructive Sterility—Obstructive sterility is commonly the result of an inflammatory stricture of the seminal tract A frequent cause is bilateral *gonococcal epididymitis* (p 2401) *Other less frequently* observed disturbances of etiologic significance are genital tuberculosis traumatic epididymo orchitis urethral strictures, chronic prostatitis and seminal vesiculitis The treatment of obstructive therapy involves the chemotherapeutic attack on infectious processes combined with manipulative or surgical measures intended to dilate or reconstruct the occluded lumen

Relative Sterility—There are occasional instances when despite seemingly normal conditions impregnation does not occur There are other instances in which impregnation is accomplished after years of a barren marriage These instances may be due to improvement in systemic conditions such as abatement of infection a restful holiday or corrective doses *of thyroid extract in hypothyroidism (p 1191) Some are* accredited, rightly or wrongly to the use of high vitamin feedings particularly wheat germ oil the rich source of vitamin E (p 629) Relative infertility is demonstrated in some instances, when the marital partners of a barren marriage become divorced and remarry and then accomplish fruitful union These episodes are explicable only upon the existence of a state of *sub fertility* or of some unknown biological incompatibility such as is observed in the blood groupings

Treatment —The observations in the preceding paragraph stimulate the practitioner who finds no local cause for sterility in a barren marriage to continue his efforts to improve systemic conditions and to encourage his patients to be of good hope High *vitamin* feedings can do no harm and *thyroid extract* may be given if it is indicated A holiday is proposed and the technic and timing of *intercourse* (p 2401) are reviewed Injections of *gonadotropins* may be useful but little can be expected from the administration of *androgen* or *estrogen*

genital hypogonadism (p 2412) *Duplication of the penis* is associated with other local anomalies such as the double bladder double urethra or the imperforate anus *Congenital cysts* are occasionally observed along the raphe These may become infected and when enlarged interfere with coitus Excision is simply performed under local anesthesia

Other penile variations include transverse or vertical clefts supernumerary glans and double glans with a simple shaft *Hermaphroditism* (p 2531) and *pseudohermaphroditism* (p 2531) require expert consultation for the determination of sex and the institution of possible corrective procedures

ANOMALIES OF THE SCROTUM

In cryptorchidism the half of the scrotum that corresponds to the undescended testis is usually rudimentary *Cleft or bifid scrotum* arises from the failure of union of the lateral halves of the organ along the median

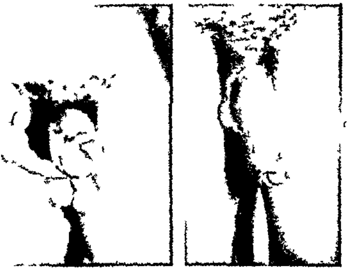


Fig 580—Inflammatory phimosis from gonorrhea

raphe and the formation of a separate pouch for each testicle *Congenital cysts* particularly dermoids of the raphe are encountered occasionally and should be removed if it is at all feasible

CRYPTORCHIDISM

One of the commonest of all congenital anomalies is failure of one or both testes to descend normally from the embryonic intra abdominal position into the scrotum It is estimated that cryptorchidism is present in approximately 10 per cent of male infants at birth In the majority of cases however descent occurs during the first year or by the time puberty is reached Nevertheless the condition is persistent in about 3 per cent of adults and is bilateral in approximately 1 per cent of the male population

The recognition and correction of cryptorchidism are important since the anomaly may be associated with sterility hypogonadism and testicular

of these anomalies requires therapy unless presenting symptoms are encountered

PHIMOSIS

With congenital phimosis the preputial orifice is sufficiently narrowed to prevent retraction of the prepuce behind the glans In the *hypertrophic type* the prepuce covers the glans but the orifice is inordinately narrowed In the *atrophic type* the prepuce is shortened and the opening is inadequate

Congenital phimosis results in the accumulation of irritating secretions beneath the prepuce It predisposes to *balanoposthitis* the formation of *preputial stones* and perhaps *carcinoma of the penis* Micturition may be impeded leading to serious back pressure upon the upper urinary tract and the kidneys Irritation from phimosis sometimes is responsible for enuresis priapism vesical irritability and masturbation Sometimes in

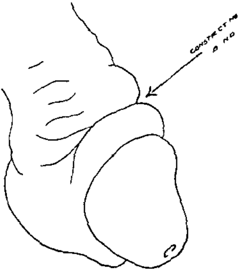


Fig 5 9—Gonorrheal paraphimosis *

women suffering from infestation with the *Trichomonas vaginalis* the infection has initiated and may have been perpetuated by a nesting of the organisms in the moist secretions underneath a tight prepuce

The frequency of congenital phimosis has led to the ritual practice of *circumcision* now carried out for hygienic reasons in most enlightened communities The technic of circumcision is described in the section on *Minor Surgery* (p 3936)

ANOMALIES OF THE PENIS

Congenital malformations of the penis which involve the urethra are elsewhere described (p 2286) Those developmental abnormalities of the penis proper which require a specialist s attention and perhaps even plastic procedures are fortunately rare The significant anomalies include *agenesis* in which the organ is absent and the urethra opens on to the perineum or the anterior rectal wall *Hypoplasia* is a manifestation of con

* From Pelouze Gonorrhea

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In cryptorchidism the half of the scrotum that corresponds to the undescended testis is usually rudimentary *Cleft or bifid scrotum* arises from the failure of union of the lateral halves of the organ along the median



Fig 580 —Inflammatory phimosis from gonorrhea

raphe and the formation of a separate pouch for each testicle *Congenital cysts* particularly dermoids of the raphe are encountered occasionally and should be removed if it is at all feasible

CRYPTORCHIDISM

One of the commonest of all congenital anomalies is failure of one or both testes to descend normally from the embryonic intra abdominal position into the scrotum It is estimated that cryptorchidism is present in approximately 10 per cent of male infants at birth In the majority of cases however descent occurs during the first year or by the time puberty is reached Nevertheless the condition is persistent in about 3 per cent of adults and is bilateral in approximately 1 per cent of the male population

The recognition and correction of cryptorchidism are important since the anomaly may be associated with sterility hypogonadism and testicular

malignancy Hormone therapy is effective in 25 per cent of cases and surgical interference is useful in many of the remaining group

Pathogenesis—During the sixth or seventh week of gestation the embryonic testes develop from the medial surface of the mesonephros within the abdominal cavity The cells of the proximal portion of the genital mass undergo atrophy while those of the distal portion proliferate Simultaneously the fetus grows in length so that there is an apparent descent of the testes to the level of the developing internal inguinal ring At the fourth intra uterine month the male gland lies just inside the internal inguinal ring and by the seventh month at the lower end of the inguinal canal Just before birth the testes normally reach their adult scrotal position The factors which influence the descent of the gland apparently include the tension of the normal intra abdominal pressure the attachment of the gubernaculum and the hormonal influences which affect the growth of the gonads and the genitals

The testes may be arrested at any point along the line of normal descent In some examples the gland remains within the abdomen but in most instances it is found just within the internal ring or within the inguinal canal Less often it locates just below the external ring (*subinguinal type*) or it may be deflected from the external ring to some abnormal position (*ectopia testes*) in the perineum (*ectopia perinealis*) at the penoscrotal junction (*ectopia penalis*) in Scarpa s triangle (*ectopia cruralis*) or toward the anterior superior iliac spine Occasionally the gland descends into the pelvis or both testes enter the same inguinal canal

Etiology—The causes of maldescent are not clearly understood In most instances however there is an anatomical defect which blocks the progress of the gland Operations on patients with cryptorchidism have revealed peritoneal adhesions deficiency or absence of scrotal gubernacular attachments absence of the internal ring or an improperly developed canal There is some evidence that testicular descent is normally influenced by chorionic gonadotropic hormones and that cryptorchidism is a manifestation of a primary or secondary hypogonadism

Pathology—The cryptorchid testis is usually atrophic The seminiferous elements are rudimentary or entirely lacking The interstitial tissue may be adequate but not uncommonly it shares in the general underdevelopment These histologic and functional changes are caused by the higher environmental temperature to which the anomalous gland is subjected and indicate that a function of the scrotum is the provision of a "cooling system" for the gonads

Cryptorchidism is associated with a high incidence of *congenital inguinal hernia.* The undescended gonad is particularly liable to *torsion* and *trauma* *Malignant degeneration* occurs with sufficient frequency to require remedial measures at an early moment

Clinical Manifestations—The pathognomonic finding of cryptorchidism is the absence of one or both testes from the scrotum True cryptorchidism is carefully distinguished from a *migratory testis* which moves back and forth between inguinal canal or in some ectopic position In the latter instance the gland lies superficially and is easily felt If the gland cannot be palpated after repeated examinations in both upright and recumbent positions it is likely that the location is intra abdominal Careful accurate localization has an important therapeutic implication since it determines the type of treatment required

Boys with undescended testes are usually of normal habitus In some however puberty is delayed and there may be eunuchoid characteristics (p 2413) Bilateral intra abdominal cryptorchidism may be attended by eunuchism (p 2413) In about one third of the afflicted, there are other congenital defects such as inguinal hernia hypospadias pilonidal sinus or clubfoot The relation of cryptorchidism to malignant neoplasms of the testes is discussed in the section on *Testicular Tumors* (p 2441)

Treatment—Treatment of cryptorchidism involves the use of chorionic gonadotropic hormone surgery or both Hormonal therapy is successful in

25 per cent of boys with true cryptorchidism and produces descent within two months Prepuberal cases are most apt to respond The most favor*able localization is within the inguinal canal and the least amenable type* for gonadotropic therapy is the intra abdominal variety

*Administration of the hormone is attended by enlargement of the ex*ternal genitalia and the occurrence of puberty regardless of the effect on the position of the gonad In children before puberty the usual dose is from 500 to 1000 rat units Older patients however require larger doses as high as 2500 units daily The usual duration of treatment is two months

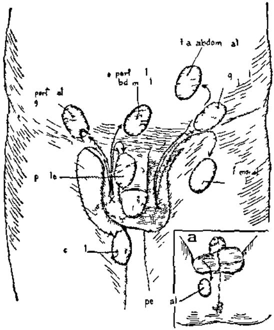


Fig 581.—Diagram ho ng various po bl pos tions in whi h a maldescended testis may locate (1) Patient s right testis not pass ng into inguinal canal accounts for the 5 subcutaneous dislocations pubic superfic al inguinal penile crural and perineal (in insert *a*) (2) Patient s left testis has passed through inguinal canal This accounts for the possible true inguinal abdominal and femoral testis

but injections are discontinued if genital growth becomes excessive or disturbances in sexuality are encountered (Fig 581)

If hormone injection is unsuccessful surgery should be considered Response to preliminary therapy makes it possible to tell at an early age whether the patient requires surgical intervention by determining whether descent is prevented by anatomic factors The injections also facilitate subsequent operative procedures by enlarging the involved parts

The surgical procedure of choice is *orchidopexy* a surgical fixation of the testis in the scrotum after the freeing of bands or kinks of the cord structures and the lengthening of the latter The two stage Torek operation yields the best results The optimum time for operation is between

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the sixth and ninth years Intra abdominal testes are removed only if they cause presenting symptoms

ANOMALIES OF THE EPIDIDYMIS

The epididymis may be abnormally situated in the scrotum in relation to the testis It may be absent or very large The testis may be cryptorchid whereas the vas deferens and epididymis descend normally in the scrotum

Should these defects produce distress the patient is referred to the specialist for surgical therapy

ANOMALIES OF THE SPERMATIC CORD

Congenital cysts and hydroceles (p 2430) may involve the testis and cord These conditions which are not infrequently observed may be mistaken for hernias Transillumination (p 3632) reveals no interference with the transmission of light *Correction* is by surgical excision or aspiration followed by the injection of a sclerosing solution

ANOMALIES OF THE SEMINAL VESICLE AMPULLA AND EJACULATORY DUCTS

Unilateral absence of the seminal vesicle associated with absence of the testis and of the vas deferens has been reported The testis may be present when the vesicle vas and epididymis are absent Anastomoses of the ampullae have been described and the ejaculatory ducts instead of emptying into the posterior urethra may open into the ureter bladder or anterior urethra These rare anomalies require specialist observation if they cause clinical disturbances

ANOMALIES OF THE VERUMONTANUM

Congenital hypertrophy of the verumontanum is a rare condition but it is important since it may be a cause of urinary obstruction in male infants and boys (p 2286)

ANOMALIES OF THE ACCESSORY SEXUAL GLANDS

Congenital cysts occurring in the prostate and bulbo urethral glands may grow intra urethrally or sub vesically They have importance particularly for the specialist as causes for urinary disturbances and obstruction to urinary flow Cysts of Cowper s glands may give rise to pain and swelling in the perineum The *diagnosis* is made by palpation and inspection Intra urethral cysts may be destroyed transurethrally with the resectoscope

Partial or *complete absence of the prostate gland* is usually associated with glandular dystrophies cryptorchidism defective development of one or both testes atrophy of the bladder or epispadias

INJURIES AND MECHANICAL DISTURBANCES

Injuries and mechanical disturbances frequently involve prepuce penis scrotum and structures contained within the latter The deeper organs are protected by their less vulnerable locality

ACQUIRED PHIMOSIS

Acquired phimosis in the adult is usually due to the effect of an inflammatory process often venereal It may be caused also by trauma

chronic irritation lack of cleanliness or the dribbling of urine As in congenital phimosis the condition may result in recurrent balanitis the formation of preputial stones a predisposition to carcinomatous degeneration of the penis or an obstructive type of uropathy

Treatment—In mild instances of acquired phimosis instruction regarding cleanliness and the use of a lubricant suffice to prevent complications In the presence of edema and inflammation the preputial sac is irrigated with a mild antiseptic and the parts are protected by a lubricant With spreading venereal lesions it may be necessary to slit the prepuce to prevent the occurrence of trophic changes in the inflamed tissues As soon as the inflammatory process has subsided *circumcision* (p 3936) is required

PARAPHIMOSIS

In paraphimosis the irreducible and retracted prepuce exerts a strangulating effect upon the glans penis The condition frequently accompanies balanitis and venereal infections The constriction compromises the blood supply of the glans which may become swollen discolored and even gangrenous

Treatment—Therapy involves attempts at gentle reduction of the prepuce The point of constriction is compressed while the prepuce is brought forward over the shaft of the penis The preputial sac is irrigated with a mild antiseptic solution and then thoroughly dried and lubricated

Should the paraphimosis be irreducible a dorsal slit is made through the constricting band to avoid more serious complications As soon as the swelling and infection have subsided *circumcision* (p 3936) is performed

PREPUTIAL CALCULI

Preputial stones always associated with phimosis are formed from salts deposited on smegma and epithelial cells or they result from the precipitation of decomposing urine that collects in the preputial sac The urinary calculi usually consist of ammonium magnesium or calcium phosphate and oxalate Rarely stones that originate in the upper urinary tract become trapped in the narrow preputial sac

Preputial stones may give rise to *balanoposthitis* with a foul smelling and bloody discharge and difficulty in urination If it is impossible to remove calculi through the normal orifice dorsal slit is made and after the inflammatory process has subsided *circumcision* (p 3936) is performed

CONTUSION OF THE PENIS

Injuries to the penis occur usually during erection since the flaccid organ is almost immune to trauma Associated involvement of the urethra must always be investigated since complicating urinary retention or extravasation (p 2309) adds immeasureably to the gravity and consequences of the injury

Contusions of the penis are quite frequently observed from trauma during an erection They are best treated with hot or cold compresses and the application of a pressure bandage in order to prevent the formation of a large hematoma which in turn may produce urethral obstruction Infected hematomas require early incision and drainage

RUPTURE OF THE PENIS

Rupture of the penis is a serious accident that usually results from violent coitus If there is an associated urethral rupture profound shock is experienced and death occurs in almost half of the afflicted A specialist consultation is required since it is necessary to divert the urinary stream as soon as the condition of the patient permits

STRANGULATION OF THE PENIS

Strangulation of the penis may occur from tight bandaging following circumcision as the result of a paraphimosis or from encirclement by a ring such as is seen in sexual perversions The injury is often complicated by necrosis of the skin and the cavernosa There may be associated gangrene of the urethra with development of a urinary fistula

Treatment requires immediate relief of the constriction Metal rings are best removed with the filing device employed by jewelers for removing rings from the fingers

SUBLUXATION OF THE PENIS

A severe blow administered to the erect penis by a blunt object may dislocate the organ into the perineum underneath the symphysis or scrotum Unless the condition is immediately detected and corrected urinary extravasation may occur with serious consequences

LACERATIONS AND WOUNDS OF THE PENIS

Lacerations and wounds of the penis produce profuse hemorrhage when the corpora cavernosa become involved It is necessary to ligate bleeding points debride the area and approximate the wound edges unless there is gross contamination Under the latter circumstance sulfanilamide powder is applied and the edges are loosely approximated until they can be more completely closed

PERIPENILE HEMATOMAS

Peripenile hematomas may accompany any penile injury If extensive they produce urinary retention and it then becomes necessary to evacuate the clot through an incision secure the bleeding point and suture the tear

CONTUSIONS AND LACERATIONS OF THE SCROTUM

Contusions of the scrotum are frequently observed as the result of blows and kicks during athletic contests and brawls and as the result of falls in the straddle position The pain of the scrotal wound is excruciating and may be accompanied by shock *Treatment* is expectant The scrotum is supported to prevent dragging Heat or cold is applied according to the preference of the patient

Lacerations and wounds of the scrotum occur as the result of stabbing gunshot or impalement They may also follow attempts at emasculation and injuries during the operation of machines Careful hemostasis is required with debridement the application of sulfanilamide powder suturing of wound edges and drainage

CONTUSIONS OF THE TESTES AND THE SPERMATIC CORD

The testes with their tunics vessels and cord structures frequently suffer from mechanical disturbances and injuries These afflictions are of

considerable clinical importance since they are often associated with profound shock and may result in atrophy hypogonadism and/or sterility

Contusions of the testis result from the same causes that produce similar lesions of the scrotum (p 2428) They are associated with profound shock and may result in instant death The immediate findings are swelling edema and tenderness Later as the result of infarction atrophy may develop and give rise to *hypogonadism impotence* and *sterility*

The immediate systemic concern in treatment is the relief of *shock* (p 937) *Local treatment* involves rest in bed and elevation of the scrotum Hot or cold applications are used according to the comfort of the patient With infection antibiotic therapy is started with streptomycin sulfonamides (p 88) or penicillin (p 106) It may be necessary to incise and drain the organ or perform an orchidectomy The latter procedure is often prevented by early incision and evacuation of a large hematoma

LUXATION OF THE TESTIS

Luxation or an acquired malposition of the testis is relatively rare The gland may be forced internally from its scrotal position or externally in cryptorchidism In either instance the specialist is summoned since the trauma may result in rupture of the tunica albuginea under which circumstance late atrophy is to be feared

TORSION OF THE TESTIS

Torsion of the testis is caused by twisting of the spermatic cord with resultant obstruction to the blood supply It occurs at any age but is more frequent during adolescence

Pathogenesis.—Torsion is usually related to some anatomic abnormality most often an undescended testis or a long mesorchium *Predisposing* causes include an elongated globus minor an abnormally narrow attachment of the blood vessels to the lower pole of the testis a large broad tunica vaginalis or absence of the gubernaculum testis The exciting factor may be exercise or violent straining although torsion has been observed during sleep A sudden spastic contraction of the cremaster muscle may be an important factor in producing torsion

Pathology.—The pathologic findings in testicular torsion are bloody fluid in the tunica vaginalis swelling induration and compression of the testis and epididymis and thrombosis of the spermatic veins below the point of twist The twist may be one-half or two full turns and may occur in either direction It is located in the free portion of the cord within the vaginal sac just above the testis The testis may be completely hemorrhagic infarcted or gangrenous An aftermath of torsion is atrophy or sloughing

Clinical Manifestations.—The onset of testicular torsion is marked by sudden severe excruciating pain nausea vomiting and shock There may be slight elevation of temperature The underlying scrotum becomes edematous and reddened The shortening of the cord results in elevation of the testis to the lower part of the inguinal canal Hydrocele not uncommonly occurs Tenderness is marked and may persist for weeks

Diagnosis.—Acute torsion of the testis must be differentiated from *strangulated hernia acute epididymitis* and *orchitis* The latter conditions are more gradual in onset The strangulated hernia is not associated with scrotal changes and is often accompanied by evidences of intestinal obstruction

Treatment —If torsion occurs in an undescended testis the gland is removed to avoid the possibility of peritonitis With a fully descended testis temporary expectant treatment is justified by rest in bed elevation of the scrotum application of an ice bag and attempts to untwist the torsion by manipulation The high incidence of atrophy after non operative measures speaks for the advisability of surgical interference with removal of the torsion and orchiectomy if the organ is not viable

DIFFERENTIAL DIAGNOSIS OF

Pain in the Scrotum and Its Contents

Pain in the region of the scrotum is most often due to lesions of testes or epididymides In most instances the diagnosis offers no difficulty since palpation clearly indicates which of the structures is involved

CLINICAL MANIFESTATIONS	AND DIAGNOSTIC FEATURES
Psychogenic	Testalgia without local findings
Renal	Referred pain in testes from disturbances of upper urinary tract, particularly with ureteral spasm as in colic due to the passage of stone (p 2311) Check x rays and refer to urologist for urography cystoscopy and catheterization of ureters
Mechanical and Physical	Following trauma After intercourse As the result of prolonged continence (testalgia erotica) With torsion of testicle requiring surgical exploration if reduction is not possible Strangulation or incarceration of hernia
Infections	Abscess cellulitis emphysema and erysipelas of the scrotum (p 2459) Orchitis in gonorrhea mumps and syphilis (p 2464) Epididymitis in tuberculosis and gonorrhea (p 2461) Get urethral smears for stain and culture Blood Wassermann Biopsy if indicated
Circulatory	Hematoma of the testes due to injury or disturbances of bleeding and coagulation. Check hemogram and bleeding and coagulation times Dragging pain with varicocele
Neoplastic –	Dragging sensation with larger malignancies Refer to specialist for biopsy and exploration

HYDROCELE OF THE TESTIS OR CORD

A hydrocele is an abnormal accumulation of serous fluid within the sac of the tunica vaginalis of the testis or the vaginal process of the spermatic cord The hydrocele of the testis is usually confined to the closed tunica sac but may communicate with the abdominal cavity Hence aspiration and therapeutic injection of a sclerosing solution is a procedure not without risk The fact that congenital and infantile hydroceles are frequently associated with hernias constitutes an additional hazard

Etiology —While many instances of hydrocele are idiopathic they may be secondary to trauma or local inflammation of the testis or epididymis The disturbance may follow local

operative procedures or it may be associated with a systemic infection such as typhoid fever pneumonia syphilis erysipelas or rheumatic fever

Clinical Manifestations—The acute hydrocele is often accompanied by pain which may be quite severe In the chronic forms the patient s atten tion is first directed to his condition by the presence of a mass or a sense of heaviness

A striking characteristic of the hydrocele is its transmission of light by transillumination (p 3632) The aspirated fluid is usually straw colored and serous Cholesterin glucose fibrinogen albumin carbonates chlorides and sometimes phosphate are demonstrable by chemical analyses

Complications (Hematocele Calcification Pyocele)—As the result of trauma or in patients suffering from a hemorrhagic disease bleeding may

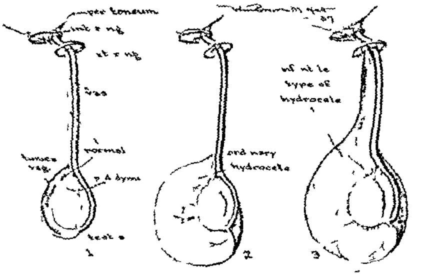


Fig 582—Schematic drawing showing (1) Normal relationship of tunica vaginalis testis (2) simple vaginal hydrocele (3) infantile hydrocele the most frequent variety See also Figs 583 and 584

occur into the hydrocele and produce a *hematocele* When bleeding is of recent origin the fluid contains fresh blood but later the exudate becomes thick and coagulated and takes on a brownish discoloration The walls of the tunica vaginalis thicken and *calcification* may produce obliteration of the entire cavity and atrophy of the testes

The *traumatic hematocele* is usually associated with pain and increase in the size of the scrotum The tumor no longer transilluminates Incision and drainage of the area are required for diagnostic purposes and to pre vent pressure and atrophy of the testes

The infected hydrocele is a *pyocele* Tenderness swelling and edema of the scrotum are associated with this complication Aspiration yields puru lent material and calls for immediate surgical intervention and chemo therapy

Greene Am J Surg April 1937

Diagnosis —The diagnosis of hydrocele is often quite difficult unless the tumor clearly transilluminates With the complications of hematocele and pyocele the transmission of the light reflex is lost and the mass cannot be differentiated from a solid tumor or an inflammatory exudate

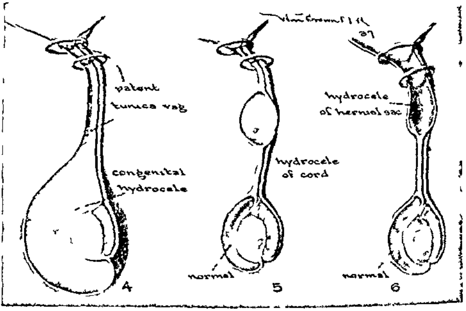


Fig 583 —(4) Congenital hydrocele (5) hydrocele (encysted) of the cord (6) congenital funicular hydrocele See also Figs 582 and 584 *

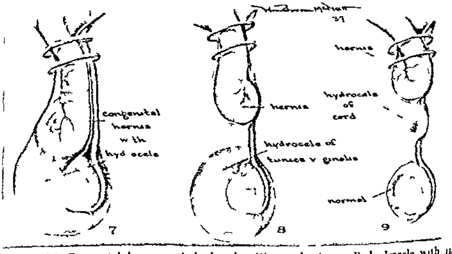


Fig 584 —(7) Congenital hernia with hydrocele (8) simple (vaginal) hydrocele with incomplete hernia (9) hernia and hydrocele of cord See also Figs 582 and 583

The hydrocele may also simulate a hernia (p 3091) with which it is often associated In consequence diagnostic aspiration is hazardous and the therapeutic injection of a sclerosing solution may lead to irreparable damage The practitioner is wise if he avoids needling of any suspected

* Greene Am J Surg, April 1937

hydrocele unless there is clear transillumination and proven integrity of the inguinal canal

Treatment—The treatment of acute hydrocele is conservative The patient is put to bed and the scrotum elevated and supported Hot or cold applications are applied and therapy is *directed toward the relief of the* more fundamental causative mechanism particularly a testicular or epididymal lesion of gonorrheal origin (p 2339)

When acute tension develops in the hydrocele and evidences of complications such as hematocele or pyocele become manifest the local structures require protection by *aspiration* or *evacuation* of the contents through surgical incision Simple aspiration is performed under local anesthesia It is a palliative procedure that is not lightly undertaken It may produce permanent alleviation in children but more often a recurrence is noted within a short span of time

Aspiration may be followed by the injection of a *sclerosing agent* such as 5 cc of sodium morrhuate or 2 to 4 cc of 13 33 per cent quinine urea hydrochloride The practitioner should keep in mind the hazard of injecting a hydrocele that communicates freely with the abdominal cavity When there is the slightest question or doubt the surgical consultant is summoned in order to explore the area by incision and drainage under direct vision

Decompression by operative intervention is mandatory with a tense hematocele or pyocele in order to prevent late testicular atrophy The wall *of the sac is subjected to histologic examination* with particular reference to the finding of neoplastic or tuberculous tissue

CHYLOCELE

The chylocele is a rare condition except in areas where there is a high incidence of *filariasis* (p 3321) In persons afflicted with filarial disease the invading parasite makes its way into the lymphatics of the cord and produces a seepage of chyle into the tunic The entire scrotum swells to gigantic size and the aspirated contents are milky and may contain demonstrable filariae (p 50)

The *treatment* of filarial chyloceles is most unsatisfactory although attempts have been made to remove the affected lymphatics by surgical means

VARICOCELE

The varicocele is formed by dilatation and elongation of the pampiniform plexus of the spermatic cord This network is formed by the spermatic (anterior) deferential (middle) and cremasteric (posterior) veins The right spermatic veins open obliquely into the vena cava while the left are set at right angles to the left renal vein Occasionally the valve at the *orifice of the left spermatic vein is absent*

Etiology.—Over 97 per cent of varicoceles occur on the *left side* suggesting that the right angle entry of the left spermatic vein into the left renal vein and the occasional absence of the valve predispose to the condition Chronic passive congestion resulting from unrelieved sexual stimulation is probably an accessory cause for varicocele since the disturbance is most frequently observed in young unmarried males and often disappears after marriage

The *right sided varicocele* or one which appears in later life suggests the possible presence of some intra abdominal condition, particularly a tumor of the kidney or a nephropathy

producing compression of the renal veins Under any circumstances the involved veins show varying degrees of dilatation tortuosity weakness of valves atrophy and thickening of the wall Phleboliths are sometimes found within the lumen

Clinical Manifestations—The varicocele rarely produces symptoms despite considerable size When the condition is noted the patient complains of a heavy dragging sensation or pain in the testis and cord Neurasthenic symptoms are not uncommon On examination the testis hangs low the scrotum is usually elongated and there are varicosities of the scrotal wall The characteristic finding is a mass of enlarged tortuous veins described as a 'bag of worms' The spontaneous varicocele' disappears in the recumbent position and refills on standing whereas the symptomatic type" due to pressure of an abdominal tumor alters with change in position



Fig 585—Bilateral varicocele that on the left side being very large It will be noted that veins of scrotal wall are varicose*

Treatment—In most instances the varicocele does not require operative interference Conservative treatment consists of the use of a snug suspensory and reassurance as to the harmlessness of the condition

Surgical therapy involves ligation and excision of the involved segments of veins (p 3939) The procedure is indicated when the vessels are greatly enlarged for the relief of persistent or severe pain as a military expediency with a history of recurrent phlebitis thrombosis or spontaneous rupture and in the presence of an associated hernia Neurasthenia' and sexual neuroses do not constitute surgical indications The injection of sclerosing agents in our experience is unsatisfactory

The treatment of the *symptomatic type* of varicocele consists in removal of the primary cause such as the tumor of the kidney

INJURIES TO THE EXCRETORY SYSTEM AND PROSTATE GLAND

Injuries to the excretory portions of the male reproductive organs and the accessory glands are of relatively rare occurrence Occasionally stric

* Herman, The Practice of Urology

tures develop as the result of an inflammatory process and calculi form in the seminal vesicles and prostate gland

Injuries to the epididymis or the vas deferens may accompany trauma to the testes or the scrotum They are managed similarly under these circumstances

The vas deferens is subject to trauma with the formation of a hematoma during the operative repair of a hernia A tender mass develops along the cord structures and the overlying skin becomes ecchymotic With rest in bed and the application of an ice bag the condition usually abates If infection sets in incision and drainage are necessary

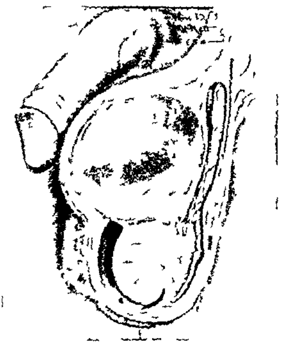


Fig 986—Drawing illustrating common type of spermatocele There is a communication between the sac and the sac of the tunica vaginalis Spermatocele was adherent to fibrous tissue of cord, to epididymis and testis Sac was removed

SPERMATOCELE

The spermatocele develops as (*1*) a dilatation of the vasa efferentia *distal to an inflammatory or traumatic stenosis (retention cyst)* (*2*) as dilatation of blind end vasa aberrantia which originally were in communication with the ducts of the seminiferous system and (*3*) as a result of cystic dilatation of rudimentary structures in the region of the epididymis (hydatid of Morgagni and the paradidymis)

The spermatocele may be solitary or multiloculated The wall is usually thin but may be calcified The content consists of a thin watery or milky white fluid containing many spermatozoa The fluid may be slightly blood tinged following trauma With a spermatocele which is not in com

munication with the seminiferous system spermatozoa may be absent and the sediment made up of fatty degenerated epithelial cells and detritus

Clinical Manifestations—The spermatocele grows slowly as a painless swelling in the head of the epididymis Gradually it may reach the size of an apple The swelling is fluctuant and painless and transilluminates clearly Its contour is globular and its surface is rarely smooth The patient may complain of a dragging sensation in the inguinal region and the presence of a tumor The testicle usually projects beyond the lower pole of the spermatocele

A hydrocele in contradistinction to the spermatocele usually envelops and covers the testicle Puncture of a spermatocele reveals the presence of spermatozoa in a fluid which is water clear or milky The fluid of a hydrocele on the other hand is usually straw colored

Treatment—A large spermatocele is best treated by *surgical extirpation* although the lesion may be aspirated and injected with sclerosing solutions (p 2433) Following treatment, the scrotum should be supported and the patient remain in bed for seventy two hours

STRICTURE OF THE VAS DEFERENS

Stricture of the vas deferens is not uncommon and usually follows trauma or infection particularly *gonorrhea* It may occur after a herniorrhaphy or a vasotomy Commonly the scrotal portion of the vas deferens is the site of the stricture In gonorrhea the narrowing is closer to the epididymis Bilateral stricture is a cause of *sterility*

The *treatment* is surgical but is not very successful The usual procedure is an attempt to anastomose the vas to the globus major of the epididymis

CALCULI OF THE SEMINAL VESICLES

True calculi of the seminal vesicles are rarely encountered They occur in men past the age of forty and are usually small They are composed of epithelial cells mucus spermatozoa and inorganic salts They lead to obstruction of the ejaculatory ducts and cause spermatic colic and bloody ejaculations True calculi are usually demonstrable in the roentgenogram but are difficult to differentiate from phleboliths

Small calculi of the seminal vesicles may be left untreated Large calculi are removed through vesiculotomy or vesiculectomy

PROSTATIC CALCULI

Prostatic calculi are relatively frequent They are usually discovered on roentgenographic examination during operation or at autopsy *Endogenous calculi* are true prostatic stones formed within the prostatic tissue *Exogenous* or *false calculi* are urinary stones that have lodged in the prostatic urethra or have formed from urinary sediments in a communicating pouch The nucleus of endogenous prostatic calculi consists of corpora amylacea blood clot epithelial debris clumps of bacteria and necrotic tissue The outer layer is made up of phosphates carbonates and oxalates Exogenous prostatic calculi contain as a nucleus urates and earthy phosphates

True prostatic calculi are usually multiple small and round They are scattered throughout the gland and located within a distended acinus

The portion of the prostate containing calculi shows evidence of infection and *stasis* Prostatic hypertrophy and prostatic calculi frequently coexist

Clinical Manifestations and Diagnosis—Most prostatic stones are silent When disturbances arise the patient may complain of frequency *nocturia* dysuria difficulty in starting the stream and pain in the penis rectum or perineum There may be dribbling incontinence or hematuria

On rectal examination pro tatic calculi *commonly give the sensation* of crepitation in a hard prostatic nodule Urethroscopy reveals the calculi in the prostatic ducts and roentgenography discloses opacities in the region of the symphysis pubis Prostatic calculi may be difficult to differentiate from tumors and infections of the prostate with which they are commonly associated



Fi 587—Roentgenogram howing an enormous calculus of prostate gland Gland had been replaced by calculus Small cystoscope was passed through groove in the stone into bladder C ep tation felt on rectal examinat on Pat ent an aged man with d abetes Not operated upon

Treatment—The treatment of *exogenous calculi* lodged in the prostatic *urethra depends upon the size* position and the degree of impaction of the stone If transcystoscopic delivery fails operative interference may be required by the suprapubic or perineal route to avoid or relieve an obstructive uropathy (p 2264)

Endogenous stones are best left undisturbed if they produce no symptoms When *obstruction or infection* develops the calculi must be removed by transurethral resection prostatotomy or prostatectomy

Patients with prostatic calculi should not be subjected to prostatic massage

Herm n The P actice of Urol gy

munication with the seminiferous system spermatozoa may be absent and the sediment made up of fatty degenerated epithelial cells and detritus

Clinical Manifestations—The spermatocele grows slowly as a painless swelling in the head of the epididymis Gradually it may reach the size of an apple The swelling is fluctuant and painless and transilluminates clearly Its contour is globular and its surface is rarely smooth The patient may complain of a dragging sensation in the inguinal region and the presence of a tumor The testicle usually projects beyond the lower pole of the spermatocele

A hydrocele in contradistinction to the spermatocele usually envelops and covers the testicle Puncture of a spermatocele reveals the presence of spermatozoa in a fluid which is water clear or milky The fluid of a hydrocele on the other hand is usually straw colored

Treatment—A large spermatocele is best treated by *surgical extirpation* although the lesion may be aspirated and injected with sclerosing solutions (p 2433) Following treatment the scrotum should be supported and the patient remain in bed for seventy two hours

STRICTURE OF THE VAS DEFERENS

Stricture of the vas deferens is not uncommon and usually follows trauma or infection particularly *gonorrhea* It may occur after a herniorrhaphy or a vasotomy Commonly the scrotal portion of the vas deferens is the site of the stricture In gonorrhea the narrowing is closer to the epididymis Bilateral stricture is a cause of *sterility*

The *treatment* is surgical but is not very successful The usual procedure is an attempt to anastomose the vas to the globus major of the epididymis

CALCULI OF THE SEMINAL VESICLES

True calculi of the seminal vesicles are rarely encountered They occur in men past the age of forty and are usually small They are composed of epithelial cells mucus spermatozoa and inorganic salts They lead to obstruction of the ejaculatory ducts and cause spermatic colic and bloody ejaculations True calculi are usually demonstrable in the roentgenogram but are difficult to differentiate from phleboliths

Small calculi of the seminal vesicles may be left untreated Large calculi are removed through vesiculotomy or vesiculectomy

PROSTATIC CALCULI

Prostatic calculi are relatively frequent They are usually discovered on roentgenographic examination during operation or at autopsy *Endogenous calculi* are true prostatic stones formed within the prostatic tissue *Exogenous* or *false calculi* are urinary stones that have lodged in the prostatic urethra or have formed from urinary sediments in a communicating pouch The nucleus of endogenous prostatic calculi consists of corpora amylacea blood clot epithelial debris clumps of bacteria and necrotic tissue. The outer layer is made up of phosphates carbonates and oxalates Exogenous prostatic calculi contain as a nucleus urates and earthy phosphates

True prostatic calculi are usually multiple small and round They are scattered throughout the gland and located within a distended acinus

The portion of the prostate containing calculi shows evidence of infection and stasis Prostatic hypertrophy and prostatic calculi frequently coexist

Clinical Manifestations and Diagnosis —Most prostatic stones are silent When disturbances arise the patient may complain of frequency nocturia dysuria difficulty in starting the stream and pain in the penis rectum or perineum There may be dribbling incontinence or hematuria

On rectal examination prostatic calculi commonly give the sensation of crepitation in a hard prostatic nodule Urethroscopy reveals the calculi in the prostatic ducts and roentgenography discloses opacities in the region of the symphysis pubis Prostatic calculi may be difficult to differentiate from tumors and infections of the prostate with which they are commonly associated



Fig 587—Roentgenogram showing an enormous calculus of prostate gland Gland had been replaced by calculus Small cystoscope was passed through groove in the stone into bladder Crepitation felt on rectal examination Patient an aged man with diabetes Not operated upon

Treatment —The treatment of *exogenous calculi* lodged in the prostatic urethra depends upon the size position and the degree of impaction of the stone If transcystoscopic delivery fails operative interference may be required by the suprapubic or perineal route to avoid or relieve an obstructive uropathy (p 2264)

Endogenous stones are best left undisturbed if they produce no symptoms When obstruction or infection develops the calculi must be removed by transurethral resection prostatotomy or prostatectomy

Patients with prostatic calculi should not be subjected to prostatic massage

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CHAPTER 116

THE MALE REPRODUCTIVE SYSTEM VASCULAR AND NEUROLOGIC DISTURBANCES NEOPLASMS

VASCULAR DISTURBANCES

DESPITE the rich vascularity of the penis disorders of the blood vessels of the male reproductive system are rarely encountered except for the *varicocele* (p 2433) On rare occasions a *thrombosis of the dorsal vein of the penis* is observed usually as the result of trauma particularly that induced by the prolonged wearing of a tight condom *Peripenile hematomas* have been previously considered (p 2428) *Infarct of the testis* may accompany torsion of that organ (p 2429)

NEUROLOGIC DISTURBANCES

The phenomenon of erection (p 2401) has a complicated neurologic pathway and may be affected by psychogenic and organic neurologic disturbances The latter are of greater importance and may result in *priapism impotence* or *testalgia*

PRIAPISM OF NERVOUS ORIGIN

Priapism of nervous origin results from ascending peripheral stimuli caused by inflammation irritation or tumors of the urethra from central stimulation of the spinal cord in association with neoplasms or leukemic infiltrations involving the nervi erigens or pudens and from descending cerebral stimuli in diseases of the brain and cord

Urethral phenomena are easily observed in routine examination and are not associated with motor or sensory findings With involvement of the cord or cerebrum the priapism is but a single manifestation of the more extensive process (p 2411)

IMPOTENCE OF NERVOUS ORIGIN

Impotence of nervous origin is encountered as a psychogenic disturbance in the vast majority of instances It may also occur with organic neurologic disease such as brain tumor cerebral arteriosclerosis general paresis tabes dorsalis and tumors or injuries of the spinal cord (p 1456)

TESTALGIA

Aside from the normal amount of pain that is the expectancy in organic lesions of the testes and epididymides testalgia may exist without a local demonstrable organic cause Occasionally this results from chronic congestion when the organs hang at low level It may follow excessive intercourse or prolonged sexual excitement without gratification Prolonged discomfort is most often associated with a profound sexual neurosis

Testalgia also arises from reflex causation notably *renal colic lumbosacral sprains* prostatitis and vesiculitis (p 2467)

Treatment —For the most part testalgia is relieved by rest and the wearing of a suspensory or jock strap Many men with an inordinate concern for sexual potency wear some type of support at all times as a sort of safe deposit vault for their precious stones In view of the psychosexual components surgical efforts to relieve testalgia are to be avoided *In desperation physicians have been forced to perform* denervation of the testes or epididymo orchidectomy Needless to say none of these drastic measures is undertaken without a written release from the patient

NEOPLASMS OF THE MALE REPRODUCTIVE ORGANS

New growths of the testes and prostate are encountered with considerable frequency The benign hypertrophy of the latter structure in point of fact has become a clinical incident of such frequency as to be referred to familiarly as old man s measles Neoplasms of the remaining organs of the male genital tract are of rare occurrence

BENIGN TUMORS OF THE PENIS

Benign tumors of the penis are of no great clinical significance *Dermoid and epithelial cysts* occur on the under surface of the penis and should be excised if they show manifestations of growth or interference with sexual intercourse Less frequently the organ is the site of a *papilloma myoma lipoma* or *lymphangioma* each of which is simply removed for histologic examination

CANCER OF THE PENIS

Carcinoma of the penis though rarely observed is most commonly seen in patients beyond the age of forty Predisposing factors include phimosis and a condyloma or keratosis of the glans

Clinical Manifestations —Cancer of the penis may appear as a *papillary growth* on the glans or prepuce as an indurated *ulcer* with a characteristic rolled and spreading margin or it may manifest itself as a rapidly growing solid *medullary tumor* The patient *is rarely seen until the late stages* particularly if the growth is hidden by a tight phimosis Pain occurs late and is usually preceded by a foul smelling discharge from the preputial sac and dysuria as the result of impingement upon the lumen of the urethra

The lesion spreads along the lymphatics or by extension onto the scrotum or lower abdomen Distant metastases are observed

Diagnosis—The malignant ulcer of the penis requires differentiation from venereal lesions Darkfield microscopy fails to show the organism of *syphilis* (p 45) Serological tests are however, not dependable since malignancy may occur in a syphilitic individual Donovan bodies are not demonstrable as in *granuloma inguinale* (p 475) and the *H ducreyi* is not present in spreads or cultures, as in *chancroid* (p 288)

The diagnosis is established or rejected with certainty by means of biopsy and *histologic examination*

Treatment—Malignancies of the penis require *amputation* of the organ at least 2 or 3 cm beyond the region of the tumor and block dissection of the lymphatic glands *Postoperative roentgen therapy* is advisable for purposes of sterilization as well as for irradiation of the regional lymphatics The results are not particularly gratifying but without operation the neoplasm becomes necrotic and death is inevitable within a short time

Prophylaxis of malignancy of the penis involves early circumcision or removal of keratoses papillomas and condylomas

SARCOMA OF THE PENIS

Sarcoma of the penis is rare *Melanosarcoma angiosarcoma fibrosarcoma spindle* and *round cell varieties* have been described These lesions arise from the corpora cavernosa and their treatment is identical with that for carcinoma Radiosensitive tumors may be managed by radiotherapy alone but this is a decision that requires the opinion of the expert

BENIGN TUMORS OF THE SCROTUM

Benign tumors of the scrotum are uncommon Those that appear in the raphe are apt to be *dermoids* In other regions *angiomas lipomas* and *epithelial cysts* are observed Excision is easily accomplished if there is any evidence of growth or any serious doubt concerning the histological structure of the tumor

CANCER OF THE SCROTUM (TAR CANCER CHIMNEY SWEEP CANCER)

Malignant tumors of the scrotum are of great rarity with the exception of the tar cancer an occupational disease of chimney sweeps in England A similar affliction occurs in cotton workers and employees in dye works who handle carcinogenic chemicals (p 573)

Cancer of the scrotum usually appears as a warty growth which remains benign for many years It may become apparent as a superficial painful ulcer covered with a scab and presenting an indurated base and edges The lesions are usually situated on the lower aspect of the scrotum and are slow growing Lymph gland involvement is late and distant metastases are uncommon Untreated the growth extends locally to involve the testes penis and perineum

Treatment requires wide excision and block dissection of the inguinal and femoral lymph nodes Involvement of the testes requires their removal since the tumor is not radiosensitive

TUMORS OF THE TESTES

The testicular neoplasms are an interesting and controversial group of tumors The majority are highly malignant and successful therapy depends on early recognition and extensive removal Despite their origin in the male gonad some malignant tumors produce excessive amounts of *chorionic gonadotropin* which are then excreted in the urine and can be found by the familiar pregnancy test (p 2496) Testicular tumors are more likely to occur in the undescended than in the normal scrotal gonad

DIFFERENTIAL DIAGNOSIS OF

Swellings and Tumors of the Scrotum and Its Contents

Because of the laxity of its tissues the scrotum may participate in swellings due to edema from whatever cause The more important solid tumors in this area are the malignancies of the testes which require histologic section for definitive diagnosis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Mechanical and Physical	Edema from whatever cause Elephantiasis usually as the result of filariasis Examine blood at night for demonstration of microfilaria (p 3321) Hydrocele (p 2430) Spermatocele (p 2435) Aspirate for determination of nature of cystic swelling
Allergy	Angioneurotic edema Note therapeutic response to epinephrine (p 3877)
Infections	Abscess cellulitis emphysema and erysipelas of scrotum (p 2459) Orchitis particularly in gonorrhea mumps and syphilis (p 2464) Epididymitis particularly in gonorrhea and tuberculosis (p 2339) Examine urethral spread by stain and culture (p 50) Get Wassermann and biopsy if indicated (p 337)
Neoplasm	Cysts and dermoids of scrotum (p 2440) Tar cancer of scrotum in chimney sweeps Get specimen for biopsy Malignancies of testes Get biopsy by puncture or preferably by surgical exploration
Circulatory	Varicocele (p 2433) Spermatocele and chylocele as revealed by aspiration (p 2435) Hematoma of the testes in hemorrhagic diatheses and as the result of trauma

There is considerable difference of opinion regarding the histogenesis of testicular tumors For practical purposes it is sufficient to recognize the *embryonal* and *adult* types each of which is subdivided into the *mixed cell (teratomas)* and the *monocellular* varieties The embryonal group constitutes the large majority of the testicular growths

Benign Tumors of the Testes—Benign tumors of the testes *uncommonly* encountered include lipomas myomas chondromas myxomas lipomas solid and cystic adenomas dermoid cysts and more complex adult or organized embryomas of benign origin

It is futile to speculate upon the nature of these tumors without histologic section They are best managed by local excision or unilateral orchidectomy The remaining testis functions adequately after operation and the threat of malignancy is removed



Fig 588—Teratoma of the testis Patient aged 45 complained of scrotal swelling (R) and intense pain in lower right abdomen and right leg No demonstrable metastasis Aschheim Zondek test normal Note tumorous nodule embedded in epididymis This is an exceedingly malignant neoplasm microscopically and notwithstanding presence of only 50 prolan U units in the blood it was our opinion that patient had metastasis involving lumbar plexus



Fig 589—Large seminoma of the testicle in a Negro aged 37 The large mass was confined by the tunica albuginea No evidence of metastasis Note small areas of necrosis in otherwise uniform tumor tissue Operative recovery

Malignant Tumors of the Testes —The commoner types of malignant testicular tumors include the seminoma the embryoma or malignant teratoma and the chorionepithelioma

* Herman The Practice of Urology

Pathology—The *seminoma* is an embryonal carcinoma arising from the cells of the seminal tubules The growth is solid homogenous and cream-colored It grows slowly replacing normal gonadal tissue On section it is firm fleshy and divided by septa into distinct lobules Microscopically the cells are large and clear resembling spermatocytes but they may be small and dark as seen in the sarcomas The seminoma is slow growing and late in the production of distant metastases

The *embryoma* or *malignant teratoma* probably arises from primitive cells—which accounts for the presence in the growth of structures derived from the three primitive germ layers The tumor is usually quite large and the cut surface presents a characteristic cystic appearance Microscopically a great variety of tissue element may be encountered including cartilage bone smooth or striated muscle tubular spaces lined with columnar cells and epithelial cell rests Usually one type of element predominates Embryomas metastasize early to the local nodes and distant organs

The *chorionepithelioma* of the testis is a rare variety of embryoma in which fetal membranes have been formed The chorionepithelioma gives rise to a malignant tumor which destroys most of the other elements of the teratoma The primary lesion usually remains small but produces widespread and early metastases with interesting hormonal manifestations (p 2444)

Clinical Features—The principal manifestation of a malignant testicular tumor is painless enlargement of the involved gonad In many instances the mass is discovered by chance during routine physical examination or else the patient s attention is directed to it by a sense of weight or fullness on the involved side Not infrequently the tumor is noted after trauma which seems to accelerate the growth of a malignant lesion

The tumor usually has a smooth surface and retains the shape of the normal gonad The rapidity of the enlargement varies with the nature of the growth being more rapid in the case of an embryoma than a seminoma or a chorionepithelioma The embryoma may increase so rapidly in size that it resembles an acute inflammatory process The scrotal skin remains freely movable over the mass but is often red and shiny from distention and the scrotal veins are prominent Rarely the spermatic cord is indurated or nodular A hydrocele may be present in addition to the testicular mass

In malignancy associated with *cryptorchidism* the diagnosis is difficult In the *inguinal variety* and in *ectopia testis* the condition is indicated by a superficial painful swelling most commonly localized on the right In *abdominal cryptorchidism* the diagnosis of malignant transformation is suggested by the presence of an abdominal tumor or of pressure symptoms (pain and edema of the legs) in the patient with congenital absence of a testis in the scrotum

Rare manifestations of a testicular malignancy include *gynecomastia* (p 2578) observed with the chorionepitheliomas and *precocious puberty* (p 2418) accompanying the relatively uncommon benign interstitial tumors The presence of distant metastases in bones lungs or liver may be the first indication of the presence of a chorionepithelioma

Hormonal Studies—The embryonal testicular tumors produce a *gonadotropic substance* which appears in the urine and may be found by the familiar pregnancy tests (p 2496) The more embryonal the tissue the more hormone is produced and excreted The greatest urinary output of gonadotropic hormone (20 000 to three million mouse units per liter) is observed with chorionepitheliomas Adult tumors of the testes both teratoma and seminoma are not attended by the excretion of the hormone

The chorionepithelioma also results in an overproduction of a feminizing factor probably an *estrogen* productive of the gynecomastia Testicular interstitial cell tumors may produce an increased excretion of *androgen* and 17 ketosteroids

Diagnosis—Clinical criteria are not relied upon in the determination of the nature of a testicular mass Surgical exploration with removal of the involved gonad is required as soon as malignancy is suspected The finding of gonadotropic hormone in the urine is presumptive evidence of the existence of a malignant lesion but a negative result must not be an excuse for procrastination

Treatment—Successful therapy depends on early diagnosis and *radical removal* of the involved gonad, the spermatic cord and the regional lymph nodes After excision of the suspected tumor its nature is determined by histologic methods If it is malignant repeated determinations of the urinary excretion of gonadotropic hormone are used as a guide to the presence of metastases Patients in whom the test remains positive after operation have metastases which are not clinically apparent or which have not

DIFFERENTIAL DIAGNOSIS OF

Malignancies of the Testes

Type	Rate of Growth	Metastases	Overlying Skin	Gynecomastia	Pregnancy Test
Seminoma	Slow	Late	Taut	Absent	Negative
Teratoma	Rapid	Early	Inflamed	Absent	Negative
Chorionepithelioma	Rapid	Early	Inflamed	Present	Positive

been detected If a positive test becomes negative there are no metastases or they are too small to give a positive test

Hormone determinations are repeated every three to six months to detect the subsequent appearance of deposits If a positive test persists after operation deep roentgen therapy is required The radiosensitivity of the tumor is indicated by the effect of therapy on the excretion of gonadotropin

If metastases are apparent at the time of the original diagnosis roentgen therapy or radium implants prolong life and surgery is not indicated In patients with chorionepithelioma metastases may regress after removal of the primary tumor

TUMORS OF THE EPIDIDYMIS

Tumors of the epididymis are of great variety The usual types are *fibromas* and *lipomas* although *carcinomas* have been reported The most common complaint is that of a lump which may be a chance finding on physical examination Pain may be present *Treatment* requires surgical removal

TUMORS OF THE VAS DEFERENS

Tumors of the vas deferens and tunica are extremely rare They may be benign and of connective tissue origin (*lipoma fibroma*) *Sarcomas* are reported occasionally and are characterized by rapid growth *Cysts of the vas deferens* usually occur as congenital anomalies

Treatment of the fibromas requires excision since sarcomatous change may occur Malignant lesions demand wide dissection with preoperative and postoperative radiotherapy

TUMORS OF THE SEMINAL VESICLES

Tumors of the seminal vesicles are uncommon The most frequent type is a *sarcoma* which occurs as an extension from the prostate gland or bladder *Primary carcinoma* is rare but *secondary carcinoma* is not uncommon as an extension from prostatic involvement *Cysts of the seminal vesicles* are encountered

The symptoms of malignancy of the seminal vesicles are pain in the region of the bony pelvis and rectum hematuria and urinary disturbances Rectal examination reveals a large hard nodular mass in the region of the structure

Treatment is by radical excision and postoperative irradiation or radium implantation At times diversion of the urinary stream is necessary The prognosis is poor despite most excellent therapy

TUMORS OF COWPER S GLANDS

Adenocarcinoma of the bulbo urethral glands is very rare and appears as an infiltration about the bulbomembranous urethra and rectum The patient notes pain in the perineum and rectum and palpates a hard mass Urinary difficulty occurs later together with pain on defecation

The diagnosis is made by inspection and palpation of the perineum and rectum The *treatment* is radical surgical excision followed by radio therapy

BENIGN PROSTATIC HYPERTROPHY

Benign hypertrophy or hyperplasia of the prostate is the most common neoplasm of the male reproductive system The exact nature of the lesion is a matter of academic dispute

Etiology —There is little definite information as to the cause of prostatic hypertrophy It is essentially a disease of middle life and has its peak of incidence between the ages of fifty five and sixty five It may be observed in the seventh decade but its existence in the young adult s almost unknown It occurs in about 35 per cent of all men and has been regarded as a fairly constant feature of the *male menopause* Its endocrine origin has been suggested by the experimental production of hyperplasia with injections of the gonadotropic hormone and large doses of estrogen The effects of the latter are inhibited by the administration of androgen There is no evidence that the hyperplasia is related to preceding infection sexual excesses or local vascular disturbances

Pathology —Hyperplasia of the prostate gland does not usually develop from the parenchyma of the organ proper but from adenomas of the small periprostatic glands One group of these lies circumferentially around the bladder neck beneath the mucous membrane and another group is situated in the submucosa of the prostatic urethra between the colliculus and the bladder neck The prostatic tubules tend to undergo pressure atrophy as the tumor grows

Microscopically these benign tumors show glandular elements connective tissue and smooth muscle cells Small abscesses and low grade infection may be present in association with adenoma of the prostate Large dilated veins often develop about the neck of the bladder and may give rise to considerable bleeding

With the growth of the adenoma the true prostatic glandular structures become compressed to form the glandular capsule The neoplasm elongates widens the posterior urethra *and elevates the neck of the bladder* and trigone *Lateral lobe* enlargement advances in travesically and intra urethrally as well as toward the rectum where the bulging may be felt quite prominently Middle lobe enlargement may be intra or extravesical The former is recognized only on cystoscopic or cystographic examination

Vesical Complications—Secondary to bladder neck obstruction the bladder wall becomes hypertrophied and trabeculated Pseudodiverticula form Infection develops with the production of cystitis posterior urethritis epididymitis prostatitis and prostatic abscess An obstructive uropathy results in complete retention overflow and incontinence or incomplete retention of varying amounts of residual urine There is no relationship between the size of the prostatic hypertrophy and the degree of impairment of bladder emptying A small middle lobe may be the cause of the greatest obstruction to urinary flow



Fig 590—Hypertrophy of lateral lobes of prostate Cross section showing lateral compression of urethra Prostatic concretions *

Upper Urinary Tract and Systemic Complications—With urinary obstruction secondary changes are noted in the upper urinary tracts and kidneys Ureterohydronephrosis bilateral hydronephrotic contracted kidneys and ureteropyelonephritis are common complications and uremia develops as a result of renal insufficiency The constitutional effects of prostatic obstruction include elevation of blood pressure and the systemic manifestations due to renal insufficiency and urinary sepsis

Clinical Manifestations—Prostatic hyperplasia of itself is of no significance and there are neither local nor systemic disturbances directly attributable to the enlargement The lesion assumes clinical importance only when urinary retention and infection occur

Prostatic hypertrophy may be asymptomatic for a long period of time being discovered accidentally in the course of a routine rectal examination which reveals a large smooth soft sharply demarcated gland Probably the earliest symptom is nocturnal or diurnal frequency The urinary stream becomes weak and thin and is associated with dribbling Urgency and interruption of the stream may be observed or the patient notes difficulty or delay in initiating urination

* MacCallum Textbook of Pathology

In the presence of infection there is burning on urination Terminal and total hematuria often occur The patient may complain of a sensation of fullness in the suprapubic region or in the perineum Acute retention may suddenly develop and necessitate catheterization

With marked retention and infection symptoms of urinary obstruction (p 2264) and urinary sepsis (p 2334) appear A very common cause of infection is catheterization (p 2235) which must be performed with rigid aseptic precautions

Vesical congestion and the presence of dilated veins in the bladder often result in bleeding which may be microscopic or massive Excessively rapid decompression of a long distended bladder may precipitate a hematuria (p 2306)

Diagnosis—The diagnosis of hypertrophy of the prostate is made in the middle aged patients by a history of urinary retention or obstruction or by the routine rectal examination in which the posterior surface of the prostate gland is palpated It is not sufficient to detect the presence of the lesion but it is also necessary to determine the degree of *obstructive uropathy* (p 2264) and the extent of the *urinary infection* (p 2336) and *renal insufficiency* (p 2275) Examination of the *urine* is carefully performed *Blood chemical studies* and tests of *renal function* (p 2240) are executed The urinary tract is visualized by *excretion* (p 2251) and *retrograde urography* (p 2251) *Cystometric determinations* are of slight value but the amount of *residual urine* (p 2264) is of great significance in establishing surgical indications

The clinical similarity between benign and malignant prostatic lesions calls for *radiographs of the skeleton* in order to determine the possible presence of metastatic deposits If possible the blood is examined for the level of *acid phosphatase* (p 2450) which rises in the presence of metastases from the prostatic cancer

Treatment—Unless there is evidence of urinary obstruction or sepsis it is our opinion that benign prostatic hypertrophy requires neither medical nor surgical treatment

Non operative Measures—*Massage* by the rectal route is ill advised and may produce considerable trauma with no expectation of altering the fundamental difficulty *Diathermy* in our experience is a futile and expensive gesture The administration of *androgen* may be attempted but we have not observed any objective evidence of diminution in the size of the hyperplastic gland from the use of *male sex hormone* or *gonadotropin* The remotely possible carcinogenic effects of androgen make us fearful of using either at the present time

As prophylactic measures the patient is instructed to avoid the consumption of alcoholic beverages or spicy foods in order to keep the urine from becoming irritating It is wise to keep the rectum empty by careful attention to bowel hygiene A most important precaution is the prevention of bladder distention and the patient is instructed to void every hour if possible and certainly at two or three hour intervals Fluids are banned after the evening meal and the bladder is emptied before retiring In the presence of nocturia it is wise to set an alarm clock one hour before the expected voiding in order to avoid excessive filling of the viscus Hot sitz baths and hot rectal irrigations can do no harm and may give the patient

a feeling that something active is being prescribed Many prostatics report more comfortable nights from the wearing of a flannel abdominal binder

The patient is placed on a *low calory diet* (p 669) and if he is on the obese side urged to effect weight reduction This is done more as a preoperative method of therapy than for its influence on the fundamental condition Candidates for surgery are urged to get themselves in optimum physical condition through measures of general hygiene, gentle exercise and the avoidance of mental and physical tension

Whereas most specialists advise against sexual excess the senior author is of the opinion that relatively frequent coitus empties the prostate of its secretion and is wholly salutary While he has no statistical evidence to back his assertions, it is his impression that patients who have had regular satisfactory sexual gratification less frequently suffer from prostatic hypertrophy than those who are continent and abstemious but frustrated in the art of love'

Management of Complications—Immediately there are evidences of bladder obstruction or urinary sepsis, the patient is referred to the consultant urologist The systemic and local examinations previously described (p 2240), are undertaken or repeated Chemotherapy with the sulfonamides (p 88) and/or streptomycin (p 104) is initiated The obstructive phenomena are relieved by catheterization, the insertion of an indwelling catheter or the performance of a preliminary cystostomy No matter what surgical procedure is performed, a prophylactic *vasectomy* (p 3938) is executed in order to prevent postoperative complications in the epididymides or testes

Surgical Therapy—As soon as the condition of the patient permits the problem of corrective surgical procedure is opened The discussion involves the choice of a transurethral resection suprapubic or perineal prostatectomy

The *transurethral procedure* through the resectoscope has many advocates and certain clearcut advantages In expert hands it is relatively simple There is no external incision The period of hospitalization is brief and the procedure may avoid the necessity of the more serious operative maneuver While the decision for or against transurethral resection rests with the consultant urologist we must confess to a lack of enthusiasm for the method The operator often is working blind There is apt to be considerable postoperative hemorrhage which is difficult to see and control Even under circumstances in which the procedure is clearly indicated a later prostatectomy often must be performed and it is possible that a malignancy may be overlooked

In the present stage of its development *prostatectomy* done during the early phases of the disease has little risk and not an overly long period of hospitalization Once the operation is completed the problem is solved There are fewer postoperative repercussions and it is not possible to overlook a malignant lesion Our experiences have been best with the *two stage suprapubic technic* The preliminary procedure, which takes but a few moments and has little risk consists of *vasectomy* and the accomplishment of a *cystostomy* After an interval of one to three weeks the condition of the patient permits of the removal of the gland which is accomplished with surprising rapidity and completeness by experienced

surgeons Postoperative bleeding is less frequently observed and more easily controlled than with the transurethral procedure The bladder catheter can be removed after several days and the wounds heal with surprising speed and minimal scarring The organ can be examined histologically for evidence of malignancy Both physician and patient have the satisfaction of knowing that the problem is definitely settled and there is little cause for further anxiety or insecurity While the prostatectomized patient is sterile he is by no means impotent and may shortly resume sexual intercourse at will

The relative merits of suprapubic and perineal prostatectomy are beyond the province of the practitioner or internist The consulting urologist performs that procedure with which he is most familiar and in which he is most expert

Pre and Postoperative Treatment—No matter which operation is performed antibiotic therapy with streptomycin (p 104) and sulfonamide (p 88) or *penicillin* is mandatory Because of the presence of urinary infection and renal insufficiency the patient is *alkalinized* and fluids are forced in order to prevent crystallization of the sulfonamide If the patient is unable to take sufficient fluid by mouth an *intravenous* drip is set up and maintained so long as there is no evidence of water retention (p 705)

Postoperative tenesmus and spasms often yield to the local application of heat and the use of the antispasmodics particularly the new synthetic *demerol* (p 3863) The danger of postoperative bleeding has been considerably lessened by the introduction of an indwelling distensible bladder which is removed through the urethra when its presence is no longer necessitated Postoperative urinary incontinence is rarely observed although *patients often complain of some disturbances in ejaculation*

CARCINOMA OF THE PROSTATE

As a cause of death among insurance policyholders carcinoma of the prostate has increased from 0 8 per cent per hundred thousand in 1917 to 3 7 per cent in 1928 Due to the increase in longevity the incidence is probably greater at the present time Early diagnosis is difficult and unusual since the tumor is present as a rule for a long time before it gives rise to symptoms Local and distant metastases are commonly present when the growth is detected but great progress has been made in the treatment of the disease through endocrine therapy

Pathology—Carcinoma of the prostate usually starts in the posterior lobe and may be associated with benign hyperplasia of other portions of the gland The tumor is a typical adenocarcinoma which varies in structure from the medullary variety with almost no stroma to a fibrotic scirrhous carcinoma It spreads by direct extension along tissue planes to neighboring structures by lymphatics to regional lymph glands and via the blood stream to bone liver and lung The first symptoms may be referable to a metastasis

Clinical Manifestations—The prostatic carcinoma is silent for a prolonged and undetermined period of time Commonly the first symptoms are those of urinary obstruction but a pelvic extension may lead to involvement of the sciatic nerve and a complaint of *sciatica* (p 3072) Bilateral sciatica is highly suggestive of prostatic malignancy Involvement of the pelvic veins gives rise to *edema* of one or both lower extremities

Pain in the spine or extremities is due to metastases to the skeleton A pathologic *fracture* may call attention to the disease Painful defecation and constipation are of late occurrence and pulmonary metastases may usher in the disease with respiratory symptoms

The chief physical sign is the rectal finding of a hard irregular and nodular prostatic enlargement The prostate is fixed and the seminal vesicles are commonly involved Occasionally a localized hard tumor is felt in a soft hypertrophied gland Such a suspicious area is removed by perineal exploration or aspirated for histologic examination

Skeletal metastases are common and are usually multiple and osteosclerotic in type The radiographic appearance closely resembles Paget's disease of bone (p 2879) The spine pelvis ribs and femur are so commonly involved that the absence of involvement of one of these sites argues against metastases

Phosphatase Activity—Carcinomatous prostatic tissue contains a large amount of acid phosphatase Upon invasion of the blood and lymph channels this enzyme escapes into the blood with the building up of an appreciable concentration More than 85 per cent of patients with metastasizing prostatic carcinoma yield high blood values while more than 90 per cent of those without roentgenographic evidence of bone involvement give relatively normal levels The determination is helpful in suggesting the presence of metastases in the absence of conclusive roentgen evidence It is of aid in the differentiation from Paget's disease and affords a clue to the primary tumor in a patient with metastases of obscure origin It is of prognostic value in following the response to therapy with one or another of the endocrine methods

Treatment—Statistics indicate that less than 5 per cent of patients with prostatic carcinoma are candidates for radical surgery In the early cases a complete perineal *prostatovesiculectomy* is indicated but even in this small select group the five year survival rate is only 50 per cent or 2 5 per cent of all patients Many surgeons believe that complete surgical removal of the smallest recognizable lesion is impossible and have abandoned radical surgery in favor of palliative measures These include roentgen therapy radium therapy and transurethral resection supplemented by orchidectomy and the use of estrogens *Deep roentgen treatment* and *radium implantation* cause marked reduction in size of the tumor but have little value in the presence of metastases *Transurethral resection* is the procedure of choice for the relief of urinary obstruction and may be performed with each recurrence of the obstructing growth

One of the great contributions to modern urology is the discovery that *bilateral orchidectomy* and the use of large doses of *estrogen* lead to the regression of prostatic carcinoma and its widespread metastases The importance of this observation in the general problem of tumor growth is readily apparent Huggins and his associates who made this important observation demonstrated that castration in man decreased the height of prostatic epithelial cells and that similar results could be obtained with large doses of diethylstilbestrol in the dog Subsequent studies showed that estrogen therapy and castration produce a sharp decrease in the acid phosphatase content of the blood of patients with prostatic carcinoma and that the chemical change was accompanied by dramatic improvement, marked

by regression of the primary neoplasm gain in weight and relief from pain Complete regressions of extensive metastatic neoplasms have been observed and removal of urinary obstruction is frequent Favorable results have been reported in about 75 per cent of patients subjected to bilateral orchidectomy In some instances the procedure is followed by the use of estrogens The ultimate worth is difficult to gauge at present since the technic is a comparatively new one As of the present writing (1945) however several patients have been successfully managed for more than two years

CHAPTER 117

THE MALE REPRODUCTIVE SYSTEM INFECTIONS AND INFLAMMATIONS THE MALE BREAST

INFECTIONS AND INFLAMMATIONS

The male reproductive organs overlying and adjacent skin surfaces and the local lymphatics participate in a wide variety of infections and inflammatory processes Venereal and non venereal diseases are inoculated into the genital zones analogues of the dermatoses appear in these areas and systemic invasions may become manifest as the result of lymphogenous or hematogenous dissemination

Treatment—In the treatment of venereal infections of the male reproductive system antibiotic therapy often yields phenomenal results For oral use sulfadiazine is preferred and 2 to 4 gm are prescribed as an initial dose with 1.5 to 2 0 gm daily thereafter Treatment is stopped in the presence of toxic manifestations but if recurrences are to be prevented should be continued for several days to a week if possible after the lesion has disappeared In sulfonamide resistant infections and in instances where speed of recovery is a factor intramuscular injections of penicillin are preferred After an initial dose of 50 000 to 100 000 units maintenance injections of 50 000 units are given at three or four hour intervals preferably without interruption It is our practice to give the first dose early in

the morning and get in six doses before bedtime in the ambulatory patient Those who are hospitalized and who have the more severe manifestations should be wakened for one or preferably two doses during the night

Combined treatment with sulfadiazine and penicillin is justified in serious or obstinate infections Under other circumstances particularly if the patient is ambulatory penicillin is reserved until the sulfonamide course has been completed

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Penis

CLINICAL MANIFESTATIONS	AND DIAGNOSTIC FEATURES
Physiological	Impotence Priapism or chordee (p 2411)
Congenital Anomalies	Hypoplasia epispadias hypospadias or duplication (p 2286) Hermaphrodism (p 2531) *Cysts of raphe (p 2423) Phimosis (p 2422)*
Venereal Infections	Primary and secondary syphilis with positive darkfield and Wassermann (p 337) Chancroid with H ducreyi on smears (p 2455) *Lymphopathia venereum with positive Frei test* (p 2457) Granuloma inguinale with Donovan bodies (p 2457) Gonorrhea with gram negative cocci in urethral discharge (p 2338)
Non venereal Infections	Paraphimosis balanoposthitis and nonspecific urethritis (p 2454) Diphtheria tuberculosis fusospirillosis and actinomycosis Check smears *and cultures (p 50)*
Analogues of Dermatoses	Lichen planus with pruritic violaceous lesions (p 2458) Psoriasis with scales elsewhere (p 2458) Contact dermatitis usually from *condom Scabies with burrows (p 2458)* Herpes with vesicle (p 435)
Neoplasms	Benign and malignant Biopsy (p 2439)
Trauma	Contusion rupture strangulation, subluxation and wounds Relieve urinary retention Give penicillin and anti-gas gangrene serum with penetrations (p 2427)
Vascular Lesions	Thrombosis of dorsal vein (p 2438) Acute and chronic cavernositis (p 2454) May require aspiration or evacuation to prevent gangrene

The End Results of Infection—In addition to their immediate effects the infections of the male reproductive organs are often followed by obstruction or stenosis of the seminal channels with or without testicular atrophy *The victim often is sterilized and may be rendered impotent he may later* suffer a superimposed hypogonadism Extension to the urinary tract may produce a complicating obstructive uropathy urinary sepsis and renal insufficiency as illustrated by neglected examples of prostatitis These complications and late sequels usually are not apparent for years and even decades following the acute process The farsighted practitioner who lives

his life with his patients does not neglect the long range problem when he deals with the obvious abnormalities

BALANOPOSTHITIS

Balanoposthitis signifies an acute inflammation of the glans penis and prepuce The cause is usually a lack of cleanliness in individuals with high grade *phimosis* It is particularly apt to occur in patients with *diabetes mellitus* and is frequently seen in association with a urethral discharge A long standing balanoposthitis predisposes to the development of a *penile epithelioma*

Clinical Manifestations —The principal manifestations are diffuse redness of the involved structures itching pain swelling and a profuse discharge with a foul odor There are superficial ulcerations of the glans The prepuce is tender and contracted at its distal end and difficult or impossible to retract There may be an associated lymphangitis of the dorsal penile lymphatics and an inguinal lymphadenitis

Treatment —If possible the foreskin is drawn back and the glans penis is washed several times daily with soap and water saline solution potassium permanganate (1 5000) or hydrogen peroxide After cleansing 10 per cent sulfathiazole ointment is applied with excellent results

If the prepuce cannot be retracted frequent subpreputial irrigations of warm potassium permanganate (1 5000) are of value In the presence of lymphangitis continuous hot wet dressings are applied and sulfathiazole is given orally A dorsal slit of the prepuce may be required to expose the glans and facilitate drainage

After subsidence of the acute process *circumcision* (p 3936) is advised

ACUTE CAVERNOSITIS

Acute cavernositis is an inflammatory process involving the corpora cavernosa It may follow a direct injury to the cavernosa urinary extravasation proximal to a urethral stricture or rupture of an infected gland of Littre It may also be the result of an infection of a thrombotic involvement of the cavernous spaces of the corpora

Clinical Manifestations —The symptoms and signs are those of an acute infection *Priapism* (p 2411) is common and pain is usually excruciating Gangrene of the penis may follow with sepsis and death

Treatment —Treatment consists of adequate sedation the application of hot or cold compresses and the use of the sulfonamides (p 88) or penicillin Incision and drainage of the infected area may be required to salvage the penis Ligation of the iliac vein has been practiced in the presence of a suppurative thrombophlebitis

CHRONIC CAVERNOSITIS (CIRCUMSCRIBED FIBROSIS PLASTIC INDURATION FIBROUS PLAQUE OR FIBROUS SCLEROSIS OF THE PENIS)

Chronic cavernositis is a condition of unknown etiology characterized by a superficial *plaque* on the dorsum of the penis It is usually seen in the middle aged but has been encountered in young adults It is apparently more common in diabetics and in syphilitics

Clinically there is a hard superficial *plaque* or *nodule* usually in the middle of the dorsum of the penis or situated on either side The area is cartilaginous or bony in consistency and may cast a shadow on radiog

raphy The overlying skin is freely movable The penis is characteristically deformed on erection and coitus may be impossible

Treatment is generally disappointing Surgical removal is difficult rarely successful and often attended by further penile deformity Iodides diathermy fibrinolysin and roentgen therapy have been tried The treatment of the accompanying diabetes or syphilis must be vigorous and successful if any local endeavor is to be of any value

CHANCROID

The chancroidal infection of the penis constitutes one of the five venereal diseases elsewhere described in greater detail (p 289) The characteristic lesion is the *soft chancre* definitive diagnosis is established by demonstrating the *H ducreyi* in stained smears and cultures and by the performance of the *skin test* with the Ducrey antigen The only certain method of eliminating the possibility of a syphilitic infection is to perform darkfield microscopy (p 45)

TUBERCULOSIS OF THE PENIS

Tuberculosis of the penis is rare It is sometimes seen in infants after ritual circumcision It may follow coitus with an individual suffering from genital tuberculosis or the penis may be secondarily infected from the kidney the prostate the seminal vesicles or extragenital skin lesions

Clinical Manifestations—The lesions may be superficial as in *lupus* or they may cause an extensive cavernositis The former appear as yellow gray white *tubercles* or as superficial irregular *ulcers* with indurated bases The edges spread slowly with a tendency to heal in one area and spread to another There may be swelling and suppuration of the inguinal lymph gland The urethral meatus is often swollen and covered with tubercles

Tuberculous cavernositis is characterized by the presence of hard nodules in the corpora and urethra They tend to grow towards the surface and cause superficial ulcerations whose character is identified by biopsy

The *tuberculous ulcer* resembles a malignant lesion a chancre or a broken down gumma Darkfield examinations (p 45) exclude primary syphilis the serologic test (p 337) should be revealing in the later syphilid but a biopsy is required for a definitive diagnosis relative to malignancy

Treatment—*Radical excision* of the diseased area and glans is practiced if the lesion is circumscribed In circumcised infants the progress of the disease is rapid despite treatment If surgery is contraindicated heliotherapy roentgen therapy and streptomycin (p 103) merit trial

DIPHTHERIA OF THE PENIS

Diphtheria of the penis may be secondary to diphtheria elsewhere or it may be primary on the genitals It has been observed after ritual circumcision in which hemostasis was accomplished by the application of saliva

The glans penis and mucosal surface of the prepuce are covered with a dirty greyish *membrane* which is firmly adherent The shaft of the penis is red and edematous and may undergo necrosis and sloughing The in

guinal lymph glands are enlarged and tender There may be systemic manifestations The spreads and cultures reveal the presence of the *Klebs Loeffler bacillus* (p 302)

Treatment requires the prompt injection of *antitoxin* (p 310) since the mortality is high especially in very young infants Supplementary antibiotic treatment with penicillin (p 106) is indicated

SYPHILIS

The *primary chancre* of syphilis (p 3278) occurs on the penis in approximately 95 per cent of all instances Though the typical *hard chancre* is described as a classical appearance the only safe rule for the practitioner to formulate is that of regarding each penile lesion as syphilitic until proved otherwise *Darkfield microscopy* (p 45) in the hands of the experts yields 100 per cent of positive evidence in the presence of a syphilitic infection The spirochete found in fusospirosis of Vincent is easily distinguished by the experienced *Serologic tests* at the time that the primary lesion first appears are of no value since they are universally negative

The *secondary eruption* of syphilis (p 3281) also appears on the genitals and assumes a variety of different forms Darkfield microscopy is again of consummate value and at this time serologic tests (p 337) furnish additional confirmation The more characteristic of the secondary eruptions are the *mucous patches* and the *condylomata lata* (p 3281)

Local applications other than a protective dressing are avoided until diagnosis is definitively established or refuted Immediately the presence of syphilis is revealed intensive *systemic therapy* (p 340) is inaugurated since seronegative primary syphilis yields satisfactory results approximating 100 per cent and in seropositive primary and secondary infections the cures exceed 90 per cent and may approach 95 per cent After these infectious lesions have subsided curability is less often experienced and unsatisfactory results increase in incidence

EROSIVE AND GANGRENOUS OR FUSOSPIRAL BALANOPOSTHITIS

Erosive and gangrenous balanoposthitis is caused by fusospirochetes resembling or identical with the organisms found in Vincent s angina (p 355) The *infection probably results from oral* contamination of the penis in an individual with a long tight foreskin The condition prevails in perverted sexual practices (p 2412) through direct contact of the penis with infected saliva or the use of saliva as a lubricant in intercourse The disease is rare in the circumcised

Clinical Manifestations —*Balanoposthitis erosiva circinata* is a relatively mild form of the affliction which begins with small greyish white patches in the preputial sac and a foul smelling yellowish discharge Burning itching and swelling are present and an acquired inflammatory *phimosis* may develop Multiple small round ulcerations covered with an adherent false membrane are present within the preputial sac The ulcerations may become diffuse and confluent involving the glans and the prepuce

Balanoposthitis gangrenosa is a more advanced stage with constitutional symptoms (chills fever nausea and vomiting) a marked edema of the subcutaneous tissues of the penis phimosis and enlarged inguinal

lymph glands Urination may be difficult in the presence of a marked phimosis The prepuce is discolored and the discharge is profuse and foul smelling Necrosis and ulcerations rapidly develop and destruction of the glans penis may occur

Diagnosis —The diagnosis of gangrenous balanoposthitis rests upon the demonstration of fusospirochetes in smears and by darkfield examination (p 45) It requires an expert observer to differentiate the Vincent spiro chete from the organism of syphilis (p 355) When there is any doubt the diagnosis of lues is made tentatively and active treatment is instituted (p 340)

Treatment —*Local therapy* is undertaken with irrigations of half strength hydrogen peroxide A zinc peroxide paste is applied to the inflamed areas In the presence of high grade phimosis a dorsal slit is made to permit retraction of the prepuce for cleaning and the application of drugs In severe infections and those refractory to treatment with the oxidizing agents topical applications of Mapharsen or arsphenamine (1 per cent in glycerine) may be tried

Systemic chemotherapy is conducted with the sulfonamides and/or penicillin The successful oral use of *sulfathiazole* in the control of fusospirochetal infections of the mouth and throat suggests that the drug may be of equal value in the treatment of balanitis *Penicillin* (p 106) may be given simultaneously by intramuscular injection if the lesion is severe Intravenous injections of mapharsen are deferred until the antibiotic results are observed

LYMPHOPATHIA VENEREUM

The penile lesion of lymphopathia venereum is usually inconsequential and evanescent It may take the form of a vesicle ulcer papule or nodule Characteristically the clinical manifestations involve the regional lymph nodes and the diagnosis is established by the performance of the *Frei* test (p 473)

Systemic chemotherapy with sulfonamides (p 88) has amazing prophylactic and curative value

GRANULOMA INGUINALE

Granuloma inguinale the least important of the venereal diseases makes its first appearance as a nodule on the penis The pathognomonic Donovan bodies (p 475) are demonstrable in scrapings made from the lesion which tends to spread over the adjacent skin surfaces but does not involve the *inguinale nodes as does lymphopathia venereum The Frei* test (p 473) and the skin reaction with the Ducrey antigen (p 289) are negative Darkfield microscopy (p 45) fails to *reveal spirochetes and the serologic* tests for syphilis are negative unless the conditions coexist The manifestations and treatment are elsewhere described in *greater detail* (p 475) Systemic chemotherapy with antimony compounds appears to have specific efficacy

HERPES PROGENITALIS

The herpetic lesion (p 434) may appear on the prepuce or the glans penis The lesion is the characteristic *vesicle* which produces itching burn

ing and pain Often the affliction is recurrent and it is best differentiated from the primary or secondary moist lesions of syphilis by darkfield microscopy and serologic tests

Local *treatment* requires cleanliness and the use of mild antiseptic dusting powders Intercourse should be prohibited as it tends to irritate the lesions

ACTINOMYCOSIS

Actinomycosis of the penis is exceedingly rare The glans becomes indurated and covered with small purulent masses perforated by small holes from which a serosanguineous secretion exudes The *ray fungus* can be demonstrated in this discharge (p 490)

Treatment is unsatisfactory and the *prognosis* is bad Iodides thymol and wide surgical excision have been recommended without consistently favorable results Probatory anti infective therapy with sulfonamide (p 88) and penicillin (p 106) holds promise for greater success

SCABIES

The scabetic penile lesion is often seen It causes severe pruritus and is characterized by the finding of the typical burrow (p 3180) The condition is treated in the manner elsewhere described (p 3181)

TRICHOMONIASIS

The *Trichomonas vaginalis* often nests in the moist lesions that exist beneath a tight prepuce (p 2422) The disturbance is of little importance in the male who may note only local itching but is capable of producing and perpetuating a vaginitis (p 2598) in his sexual partner The treatment of her difficulty requires that the male submit to circumcision

THE DERMATOSES

Certain of the dermatoses appear on the penis and give rise to diagnostic difficulty since they simulate the venereal infections The flat violaceous plaque of *lichen planus* (p 3389) with its intense itching should offer no difficulty particularly if other lesions are visible The scaling appearance of *psoriasis* (p 3414) occurs on the penis but is always accompanied by more characteristic eruptions elsewhere *Contact dermatitis* of the penis is not unusual and often results from the materials used in the condom

ABSCESS OF THE SCROTUM

Abscess of the scrotum results from pyogenic infections of the skin the underlying epididymis or testis After preliminary anti infective therapy with sulfonamides (p 88) and/or penicillin incision and drainage may be required epididymectomy or epididymo orchidectomy may be necessary if the lesion is deep seated

EMPHYSEMA OF THE SCROTUM

Emphysema of the scrotum accompanies generalized subcutaneous emphysema scrotal gangrene and infections due to gas producing organisms (p 300)

Multiple incisions with drainage are instituted In the presence of anaerobic bacteria anaerobic antitoxin and anti gas gangrene serum are

employed (p 300) Intensive treatment with sulfonamides (p 88) and penicillin should precede and follow surgery

ERYSIPELAS OF THE SCROTUM

Erysipelas of the scrotum is usually seen in old and debilitated individuals although it may occur at any age The causative agent is the *beta hemolytic streptococcus* (p 158)

The constitutional symptoms are elsewhere described (p 167) The local manifestations beyond those which usually characterize the lesion consist of extensive edema due to the laxity of the tissues and retention of urine as the result of urethral obstruction

Intensive therapy with the sulfonamides (p 88) and/or penicillin (p 106) is required in prompt and large dosage in order to cause the most rapid regression of the process Serotherapy (p 171) is included in the regimen if symptoms of toxicity are superimposed

ELEPHANTIASIS OF THE SCROTUM

Elephantiasis of the scrotum is marked by diffuse enlargement of the sac with a hard edema and a hyperplasia of the skin and subcutaneous tissues It is the result of a local disturbance in the lymphatic drainage The variety due to the *Filaria sanguinis hominis* (p 3321) is observed in tropical countries The nonfilarial type of elephantiasis is caused by obstruction of the scrotal lymphatics by chronic inflammation syphilitic hyperplasia lymphogranuloma venereum trauma inguinal adenitis or congestion from low grade infection

As a result of lymphatic stasis lymphatic varicosities and edema develop in the lower extremities and scrotum The latter becomes markedly enlarged the inguinal and femoral lymph glands enlarge and the tissues become hypertrophied An erysipeloid inflammation is a frequent complication

Clinical Manifestations —The clinical findings in the filarial type are a diffuse enlargement of the scrotum with progressively increasing induration and edema The scrotum in this condition may weigh as much as 200 pounds The scrotal skin becomes leathery rough and coarse It is thickest at the bottom thin at the top thin and soft at the sides The scrotal mass becomes pyriform in shape the apex pointing towards the anus the mouths of the follicles are sometimes very distinct and the skin pits very little on pressure The penis is usually not involved but appears small because it is retracted by the gradual extension of the surrounding scrotal tissues As a result of trauma and infection secondary ulcerations are common

The spermatic cords are thickened and hydrocele is usually present Orchitis and atrophy of the testes result sooner or later The chief discomfort is due to the size of the involved parts and pain is present only with the attacks of acute inflammation Coitus becomes mechanically impossible Gangrene and abscess formation may develop Rupture of varices results in the escape of lymph

The local phenomena are aggravated by recurrent acute attacks of lymphangitis and lymphadenitis These exaggerate the previous findings and are accompanied by constitutional symptoms such as pyrexia chills delirium headache vomiting and nausea

ing and pain Often the affliction is recurrent and it is best differentiated from the primary or secondary moist lesions of syphilis by darkfield microscopy and serologic tests

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of gangrene appear in the most dependent regions These coalesce and spread to the groin and pubic regions The entire scrotum may become necrotic After the formation of a line of demarcation the gangrenous integument is sloughed off The testes are usually denuded to the tunica vaginalis The exposed structures are free from infection and are relatively insensitive In rare instances profuse hemorrhage results from involvement of one of the deep blood vessels There is usually a severe systemic reaction characterized by nausea vomiting chills high fever prostration and delirium

After removal of the slough healing is rapid and there may be complete regeneration of the scrotal and adjacent skin surfaces If the condition is recognized early and treated radically the outcome is usually favorable However the mortality is high when the process extends beyond the scrotum and penis

Treatment —Early multiple incisions of the involved area are generally advised to facilitate drainage prevent local emphysema and combat toxemia Intensive treatment with *penicillin* (p 106) and/or the *sulfonamides* is initiated as soon as the diagnosis is made *Local treatment* includes *irrigations with hydrogen peroxide and hot wet dressings of potassium permanganate* (1 500) Zinc peroxide paste is applied and is effective against anaerobic and micro aerophilic streptococci Gangrenous areas are removed and the exposed areas are protected by sterile dressings Cod liver oil ointment is useful in promoting healing It may be necessary to cover extensively denuded areas with skin grafts

In secondary gangrene an attempt is made additionally to correct the underlying cause

ACUTE EPIDIDYMITIS

Acute epididymitis results usually from direct bacterial invasion from the urethra but less often it arises as a metastatic manifestation The most common provocative agent is the gonococcus Other bacteria which may be encountered include the staphylococcus streptococcus *B coli* and *B typhosus* Factors predisposing to epididymitis are sexual stimulation and trauma particularly urethral instrumentation (p 2235)

Clinical Manifestations —Acute epididymitis is characterized by fever severe testicular pain radiating to the groin and flank and a tense tender swelling of the epididymis distinct from the testi Not infrequently an acute hydrocele develops The overlying scrotum becomes edematous and reddened With involvement of the testis the epididymis cannot be separately demarcated When the adjacent vas deferens is also infected it reveals itself as a thickened firm and tender cord (*funiculitis*) Rectal examination frequently reveals tender swelling of prostate and seminal vesicles

Course —Acute epididymitis may subside spontaneously in a short time or the course may be quite severe terminating with abscess formation The latter is more common with nonspecific bacteria than with the gonococcus With the subsidence of the process on one side the other epididymis may become involved Bilateral epididymitis is often followed by *azospermia* and *sterility*

Diagnosis —Most patients with acute epididymitis are infected with the

Diagnosis —The diagnosis of the filarial variety rests upon the finding of the parasite in the peripheral blood at midnight (p 3324) Eosinophilia and leukocytosis may be present A history of residence in the tropics is of value as is also an associated lymphangitis with constitutional symptoms

Treatment —The systemic treatment of filarial elephantiasis is elsewhere discussed (p 3325) Locally the worms often die after plugging a lymph trunk especially after an attack of lymphangitis, thus effecting a spontaneous cure of the active infection Instances have been reported of surgical excision of the entrapped worm with part of the scrotum and the inguinal lymph glands

Excessive swelling and induration may require the radical removal of the thickened edematous scrotal mass and excision of the blocked lymphatics Later plastic procedures are introduced to cover the denuded area of the scrotum and penis

Treatment of the nonfilarial type of elephantiasis should be directed at the primary cause Antiluetic treatment should be instituted in syphilitic infections the sulfonamides and penicillin are used in other instances

ANGIONEUROTIC EDEMA OF THE SCROTUM

Angioneurotic edema (p 3349) may involve the scrotum and penis alone or be part of involvement of other parts of the body If the swelling is severe urinary obstruction (p 2264) may develop demanding urgent measures for relief If antihistamines such as pyribenzamine (p 565) are ineffective an attempt should be made to introduce an indwelling catheter If this fails a suprapubic cystostomy may have to be performed

GANGRENE OF THE SCROTUM

Gangrene is a frequent terminal event in inflammatory processes involving scrotal skin *Idiopathic* or *spontaneous gangrene* occurs in the absence of any preexistent local or systemic cause *Secondary gangrene* develops as a complication of systemic infections circulatory disorders urinary extravasation local infections of the penis or mechanical chemical and thermal injuries The basic lesion is a widespread thrombosis of the cutaneous vessels

Etiology and Pathogenesis.—*Idiopathic scrotal gangrene* appears suddenly in males who are apparently healthy in all other respects It is usually seen after the age of forty and comprises 50 per cent of all cases of scrotal gangrene The causative organism may be *B aerogenes capsulatus* a gas producing anaerobe or the *Streptococcus haemolyticus* In some cases anaerobes are present in symbiosis with streptococci Minute breaks of the skin, phimosis urethritis inguinal adenitis and a lack of genital cleanliness predispose to the affliction

Secondary gangrene of the scrotum occurs as a complication of some local genital disorder or systemic disease It is common as a sequel of urinary extravasation It is also seen in association with balanoposthitis chancroid and erosive gangrenous balanitis Occasionally it occurs after prostatectomy or the needling of a hydrocele In most instances vascular thrombosis precedes the infection

Clinical Manifestations —The onset of gangrene of the scrotum is marked by the sudden appearance of acute inflammation of the skin of the scrotum and penis There is marked edema and redness which may extend onto the abdominal wall and perineum In infections caused by gas forming organisms palpation reveals crepitation Soon after the onset, small areas

development but children and elderly individuals are not immune Involvement of the testis without accompanying epididymal tuberculosis does not occur except in *miliary tuberculosis* (p 261) Involvement of the testis is always secondary to involvement of the epididymis in chronic urogenital tuberculosis

Epididymal tuberculosis is practically always secondary to a primary focus in the lymph glands or lungs (p 252) The epididymis is commonly the first place of localization of the genital process and existed as the only tuberculous focus in 25 per cent of autopsied cases of genital tuberculosis In the remaining 75 per cent the seminal vesicles or the prostate were also involved and very frequently there was an associated tuberculosis of the urinary organs

Pathology—The early pathologic changes consist of desquamation degeneration of the lumin epithelium of the ducts and infiltration with leukocytes Tubercle bacilli are found in the lumina of the ducts Some foci of infiltration develop with lymphocytes plasma cells and leukocytes Tubercle formation is noted in the interstitial and subepithelial tissues Caseation and abscess formation ensue and eventually the *testis* becomes involved usually by way of the lymphatics but less commonly along the ducts The testicular involvement manifests itself by radially arranged rows of tubercles More common than testicular involvement is infection of the *vas deferens* which becomes the site of infiltration nodulation caseation and abscess formation That portion of the vas deferens adjacent to the epididymis is more frequently and more intensively involved but nodules may be present in the inguinal region and adjacent to the seminal vesicles The covering of the testis epididymis and the scrotum become involved with the formation of cold abscesses and fistulas

Trauma gonorrhea and excessive sexual activity rarely precede the onset of tuberculous epididymitis

Clinical Manifestations—Epididymal tuberculosis usually causes few complaints at the onset and the patient is unaware of the existence of the disease for a long time A slight pain in the testis usually attracts attention to the presence of a thickening in the region of the epididymis Less often the disease is ushered in by an acute and stormy onset associated with fever severe pain and constitutional symptoms An acute hydrocele swelling and redness of the scrotum and infiltration of the vas deferens are usually present

The urine usually appears clear and normal A large amount of pus in the urine indicates associated development of involvement of the urinary tract

Course and Complications—The acute process usually subsides rapidly but the thickening and infiltration of the epididymis remain particularly in the tail of the epididymis Although the testis is not involved in the early stages it later becomes part of an inflammatory mass The vas deferens especially the portion adjacent to the epididymis is infiltrated and nodular Frequently the prostate and seminal vesicles present tuberculous infiltrations and the scrotum becomes adherent Abscesses of the epididymis with scrotal fistula formation are late manifestations A fistula may open and close intermittently with resultant recrudescence and extension of the tubercular process Spontaneous healing of an epididymal tuberculosis without total and complete caseation and complete destruction of the organ is a rarity

Epididymal tuberculosis is bilateral in 50 to 75 per cent of the afflicted Months or years may intervene between the original localization and in

gonococcus the complication arising from the second to the fourth week after the initial infection In consequence urethral and prostatic secretions and urine specimens are examined carefully by spread and culture in each epididymal infection Nonspecific acute epididymitis must be differentiated from *hematoma* of the epididymis which usually is not associated with signs of acute inflammation

Treatment—The *prevention* of acute epididymitis requires the avoidance of sexual or physical strain and instrumentation in patients with urinary tract infections prostatitis or seminal vesiculitis In cases infected by gonococci the prophylactic and intensive uses of sulfonamide and penicillin promise to result in virtual elimination of the complication

Active treatment of acute epididymitis consists of bed rest scrotal support and the application of wet compresses Intra urethral manipulations or instillations and sexual excitement are avoided The sulfonamides are administered in large doses using 4 gm for the initial amount and penicillin is given intramuscularly *Abscess of the epididymis* calls for incision and drainage

CHRONIC EPIDIDYMITIS

Chronic epididymitis usually follows an acute inflammation of the epididymis but it may develop slowly and progressively simulating a tuberculous infection (p 2462) The primarily chronic processes follow an upper respiratory inflammation or an acute enteritis Staphylococci colon bacilli and streptococci are the bacterial agents usually encountered Trauma is a predisposing cause and purely traumatic chronic epididymitis has been observed The *epididymitis erotica* is believed due to prolonged sexual continence

Clinical Manifestations—Symptoms of chronic epididymitis are pain which is usually not severe and a tender ovoid swelling above the testis The latter and the vas deferens remain uninvolved while the prostate and seminal vesicles may be normal on palpation or may present signs of a co existing inflammation In metastatic chronic epididymitis as well as in the traumatic varieties the urine is clear

The infiltration gradually recedes after weeks or months leaving only small areas of thickening Abscess and fistula formation are extremely rare

Diagnosis—Chronic epididymitis may simulate early *tuberculous epididymitis* (p 2462) The lack of tuberculous foci in other parts of the uro genital system and the absence of abscess or fistula formation or adhesion of the scrotum help in the differential diagnosis With *syphilitic epididymitis* (p 2465) the serologic tests are strongly positive On suspicion of *neoplasm* a biopsy is required

Treatment—Local treatment consists of support hot applications and hot sitz baths Sulfonamides and penicillin are administered in adequate dosage and foci of infection in the urethra prostate or seminal vesicles are eliminated

Surgical intervention is indicated if a tuberculous epididymitis or neoplasm is suspected

TUBERCULOUS EPIDIDYMITIS AND EPIDIDYMO ORCHITIS

Tuberculosis is a common cause of chronic inflammation of the epididymis and testis It occurs most frequently during the period of sexual

Convalescent serum (p 483) from patients recently recovered from mumps reduces the incidence of orchitis if it is used early but has little effect once the complication has arisen Despite this the injection can do no harm and may be supplemented by therapy with sulfonamide and penicillin if the course is progressively unfavorable Diethylstilbestrol in doses of 4 mg daily for seven days produces a chemical castration which gives promise of prophylactic value in mumps

Epididymo orchitis is managed in the same manner as *acute epididymitis* (p 2461)

SYPHILITIC ORCHITIS

In contrast to tuberculosis syphilis usually affects the testis rather than the epididymis although in rare instances the epididymis is also involved Syphilitic orchitis generally occurs during the secondary and tertiary stages of acquired disease and is rarely congenital

Pathology—Syphilitic lesions of the testes may be of the fibrous or the granulomatous type The former involves the interstitial tissue of the entire testis the tunica albuginea and the capillaries in an inflammatory productive connective tissue reaction which eventually leads to constriction and atrophy of the seminiferous tubules

The granulomatous type of syphilitic orchitis is characterized by small and large circumscribed solitary or multiple gummatous formations consisting of lymphocytes epithelial cells giant cells and specific granulation tissue Caseation and caseopurulent decomposition with fistula formation may develop Irregular contraction and atrophy of the testicle also occur

Clinical Manifestations—The testis undergoes a diffuse irregular painless enlargement The swelling rarely develops rapidly and the blood vessels of the cord structures often present inflammatory infiltrations The swelling particularly with the granulomatous form may reach the size of a fist and attract the attention of the patient by its size A slight hydrocele is usually found With the formation of a fistula as a result of the breaking down of a gumma the involved scrotal skin becomes undermined ulcerated and covered with a dirty mucoid exudate A syphilitic fistula is usually situated on the anterior aspect of the scrotum in contradistinction to the tuberculous variety which occurs on the posterior scrotal wall

Diagnosis—Syphilitic orchitis differs from the *tuberculous process* which affects the epididymis as well as the testis The presence of positive blood serology aids in the diagnosis which is also abetted by the results of the therapeutic test with iodide and the arsenicals Syphilitic orchitis may be difficult of clinical differentiation from *malignant tumors* of the testis (p 2442) With any questionable testicular mass the safest method of diagnosis is *exploration* and *biopsy*

Treatment—*Systemic therapy* should be instituted early in order to avoid testicular atrophy which otherwise invariably occurs Spermatogenesis and patency of the ducts may be preserved despite the presence of multiple fistulas When the process is unilateral particularly in elderly individuals *orchiectomy* is advised especially when the gummas are very large If there is the slightest suspicion that the lesion is of a malignant nature surgical intervention is mandatory

LEPROSY OF THE TESTIS AND EPIDIDYMIS

Leprosy (p 273) produces multiple nodular infiltrations of the testis and epididymis and gives rise to fistula formation It resembles tuberculosis of the epididymis and testis

volvement of the contralateral side Rarely does the process arise on both sides at the same time With bilateral involvement there is diminution in sexual potency azospermia and sterility

Epididymal tuberculosis is a serious event and may be the source for dissemination to other organs with the production of *tuberculous meningitis* and *miliary tuberculosis* Twenty to 30 per cent of all male patients with genital tuberculosis die from meningeal involvement

Diagnosis—Diagnosis early in the disease is generally difficult but in late stages the condition is easily recognized The finding of tubercle bacilli in the urine and nodular infiltrations of the prostate and seminal vesicles indicate the diagnosis In *syphilitic epididymitis* (p 2465) the serologic tests are positive If *malignancy* is suspected biopsy should be performed

Treatment—The treatment of tuberculous epididymitis requires *epididymectomy* or *epididymo orchidectomy* In most cases with the removal of the focus the process in the prostate and seminal vesicles recedes Complete or permanent cure of seminal vesicle and prostatic tuberculosis however is not to be expected nor is prevention of involvement of the other epididymis often achieved After epididymectomy 20 to 30 per cent of patients later develop a contralateral epididymal tuberculosis while without unilateral epididymectomy 50 to 70 per cent eventually suffer bilateral involvement Supplementary streptomycin therapy (p 103) merits trial

ACUTE ORCHITIS

Acute orchitis occurs as a metastatic genital complication of a systemic process and as an extension from local infection of the epididymis

Metastatic Orchitis—Acute orchitis is most commonly seen as a manifestation of *mumps* (p 480) but occasional instances have been reported during typhoid fever malaria, influenza pneumonia or general sepsis The organ becomes swollen and acutely tender In some instances abscess formation occurs and points through the anterior scrotum whereas epididymal abscess points posteriorly

In mumps there is no suppuration but a widespread degeneration of the testicular tubules The patient notes fever testicular pain swelling and constitutional symptoms Mumps orchitis is usually unilateral and occurs about a week after the parotitis although occasionally it precedes the facial swelling After subsidence of the acute process atrophy is common and the gland is small and fibrotic Mumps orchitis is a common cause for *sterility* and *hypogonadism* The latter is most commonly observed if the infection occurs prepuberally

Acute Orchitis by Extension—Acute orchitis by extension is usually secondary to an acute epididymitis The latter infection is usually the more severe but occasionally it is overshadowed by the orchitis which may go on to extensive suppuration and necrosis Abscesses are not infrequent and point anteriorly The clinical picture is similar to that of *acute epididymitis* (p 2461)

Treatment—The inflamed testis whether involved by metastasis or local extension should be elevated and cold compresses applied In severe cases decompression of the swollen organ by incision of the tunica albuginea is advocated in order to prevent atrophy and gangrene Abscesses should be incised and drained In patients with widespread suppuration orchiectomy is often necessary

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The *diagnosis* is established by the presence of lesions in other part of the body and biopsy studies Only systemic therapy is available

ACTINOMYCOSIS OF THE TESTIS AND EPIDIDYMIS

Actinomycosis of the testis and epididymis produces a diffuse infiltration with fistula formation The *diagnosis* is established by finding sulfur granules and the actinomyces in the discharge and tissue

The *treatment* is that of *actinomycosis* (p 489)

NONSPECIFIC DEFERENTITIS

Infections involving the testis epididymis and posterior urethra readily extend to the vas deferens The complication becomes apparent when the pain tenderness and swelling advance to include the site of the vas Abscess formation may occur but more often the lesion subsides within a few weeks

Local *treatment* consists of bed rest sedation and the application of hot or cold compresses Incision and drainage are required in the event of abscess formation Therapy with sulfonamides and penicillin has however made the condition a clinical rarity

GONORRHEAL DEFERENTITIS (FUNICULITIS)

The vas deferens often becomes involved in acute gonorrheal epididymitis (p 2339) Gonorrheal deferentitis, however has been described without involvement of the epididymis or testis The focus for the infection is the posterior urethra the vas deferens being infected by way of the lymphatics or through retrograde peristalsis

The symptoms are those of nonspecific deferentitis A urethral discharge shreds in the urine and the finding of the gonococcus help in establishing the diagnosis The inflammation usually subsides in a short time without abscess formation Occasionally gonorrheal deferentitis has been considered a cause for an obscure intra abdominal abscess

Local *treatment* includes bed rest support and the use of hot or cold compresses The use of sulfadiazine or penicillin prevents or rapidly ameliorates the condition

TUBERCULOSIS OF THE VAS DEFERENS

Tuberculous deferentitis is commonly associated with tuberculosis of the epididymis and seminal vesicles The involvement of the vas leads to thickening and nodulation and may occur at either end or throughout the entire length

Treatment is similar to that of *tuberculous epididymitis* (p 2462)

SYPHILIS OF THE VAS DEFERENS

Syphilis of the vas deferens is an exceedingly rare condition It produces an enlargement of the vas which may reach the size of an orange and obliteration of the blood vessels of the cord The course of syphilis of the vas deferens is similar to that of syphilitic orchitis No local treatment is required

ACUTE SEMINAL VESICULITIS

Acute seminal vesiculitis usually results from spread of infection from the urethra bladder prostate or epididymis The *gonococcus* is the most frequent bacterial agent producing an acute infection Organisms reach the seminal vesicles along the ducts or by way of the lymphatics Rarely is the infection blood borne

Edema leukocytic infiltration of the mucosa and proliferation and des quamation of the epithelium are observed in the early stages Later the entire wall of the seminal vesicle becomes thickened and the lumen dis torted

Clinical Manifestations —Acute vesiculitis gives rise to pain in the perin eum and posterior urethra The discomfort is particularly severe at the end of urination or defecation and radiates to the back and testes The pain may be colicky in nature and may occur during coitus The distended seminal vesicles being in close relationship to the lower ureter may pro duce a *ureteritis* with resultant back pressure and *renal colic* When acute seminal vesiculitis accompanies a prostatitis the symptoms are difficult to differentiate from those of the prostatic infection The urine is usually cloudy due to the admixture of purulent seminal secretion and as the re sult of the associated cystitis and urethritis

Rectal examination reveals the tender distended and infiltrated seminal vesicle The perivesicular tissue is commonly involved and the prostate *gland is usually tender enlarged and indurated Extension into the peri prostatic venous plexus* is attended by sepsis

The acutely inflamed seminal vesicle may rupture into the rectum bladder or peritoneal cavity

Treatment —The patient with acute seminal vesiculitis should be ad vised to go to bed and avoid all forms of stimulation spicy foods and alco holic beverages Hot sitz baths and rectal irrigations are soothing and helpful in reducing congestion but massage and rough palpation of an acutely inflamed seminal vesicle should be avoided for fear of spreading *infection The relief of pain may require the use of opiates (p 3856)* Ther apy with sulfonamides (p 88) and penicillin prevents and ameliorates most infections

CHRONIC SEMINAL VESICULITIS

Chronic seminal vesiculitis like chronic prostatitis may be due to the gonococcus staphylococcus or streptococcus or to colon or typhoid bacilli The symptoms resemble those of the acute variety (p 2467) except that the manifestations are less intense There may be sexual disturbances with *painful and bloody ejaculations The course of the infection may be punc* tuated by recurrent attacks of *epididymitis* and *polyarthritis*

The *diagnosis* is made from the rectal findings and microscopic exam ination of the secretion from the seminal vesicle *Urethroscopy* reveals purulent seminal secretions exuding from ejaculatory ducts The colliculus is swollen and inflamed *Cystoscopy* often shows swelling and inflamma tion in the region of the ureteral orifices particularly when an acutely in flamed seminal vesicle is about to rupture into the bladder

With chronic seminal vesiculitis gentle *massage* is indicated The mas sage should be of short *duration and carried out* twice weekly from above

downward and from without inward after the bladder has been previously filled with boric acid solution Sulfonamide or penicillin therapy is begun Incision and drainage are rarely necessary Should the clinical course be severe or the life of the patient endangered as a result of involvement of the periprostatic plexus of veins surgical intervention may become immediately urgent

Chronic seminal vesiculitis that is a cause of recurrent attacks of polyarthritis or of chronic invalidism may necessitate excision of the structure through the ischiorectal route In marked perivesiculitis merely splitting the seminal vesicle for drainage is often satisfactory No form of surgery should be instituted however until there has been a thorough trial with systemic sulfonamide and penicillin therapy since the chronic infections often respond to these drugs in a manner that exceeds all expectation

TUBERCULOSIS OF THE SEMINAL VESICLES

The seminal vesicle is less frequently the focus for genital tuberculosis than the prostate gland The infection usually extends from the epididymis along the duct system or by way of the lymphatics Less frequently tuberculous seminal vesiculitis is of hematogenous dissemination

Pathology—In the early stage there is noted a proliferation and desquamation of the epithelium with an infiltration of leukocytes Later tubercle formation occurs in the wall of the seminal vesicle and this is followed by a caseous destruction of the organ The involved seminal vesicle may rupture into the rectum or bladder or through the prostate gland into the urethra The process may extend along the lymphatics to involve the connective tissue of the bony pelvis and set up a severe infiltrative perivesiculitis and periprostatitis leading to the formation of abscesses it may perforate into the perineum or the ischiorectal fossa and form a fistula

In more favorable instances the tuberculous process becomes encapsulated and calcified but complete healing is an extreme rarity More often tubercle bacilli and foci of caseation remain latent within the surrounding dense connective tissue

Clinical Manifestations—So long as the tuberculous process is confined to the seminal vesicle there is at most an uncomfortable feeling of pressure in the perineum or posterior urethra slight pain on urination mild frequency or urgency and terminal dysuria There is very little or no pain on ejaculation and the semen is rarely bloody The disease may go unrecognized for a long time unless routine rectal examination reveals that the seminal vesicle is thickened infiltrated and nodular In the tuberculous patient such findings require examination of the semen for tubercle bacilli by means of smears and guinea pig inoculation

The course of the affliction may remain mild for a long time or it may rapidly progress in association with tuberculosis of the prostate gland and epididymis Massage of the diseased vesicle may be followed by rapid dissemination terminating in a tuberculous meningitis or miliary invasion

Treatment—The treatment of tuberculous seminal vesiculitis proceeds along general hygienic lines Local treatment particularly massage is strictly forbidden Hot sitz baths suppositories of belladonna and opium and tablets of methylene blue allay distress Surgical eradication of a focus in the kidney or epididymis may be followed by remarkable resorption of infiltrations in the seminal vesicle With residual infection seminal vesiculectomy is discussed More radical views favor the extirpation of the

seminal vesicles prostate gland vasa deferentia and epididymides Surgery is deferred until trial with streptomycin sulfonamides and penicillin has eliminated the factors due to secondary nontuberculous involvement

INFECTIONS OF THE EJACULATORY DUCTS AND VERUMONTANUM

Infections of the ejaculatory ducts and the verumontanum are associated with processes affecting the seminal vesicles prostate gland and posterior urethra Inflammatory edema and infiltrative changes produce obstruction of the ducts giving rise to sterility impotence and sexual neuroses The clinical manifestations of these infections are similar to those of the posterior urethra seminal vesicles and prostate gland Dilatation and catheterization of the ejaculatory ducts have been advocated but must be performed by experts with special technical training

ACUTE COWPERITIS

Acute cowperitis is commonly due to the gonococcus but other non specific bacteria may infect the bulbo urethral gland as secondary invaders after an attack of *gonorrhea* In most cases infection occurs by direct extension along the ducts which open into the posterior urethra

Clinical Manifestations—An acute inflammation of the bulbo urethral glands occurs after the third week of a gonorrheal urethritis Trauma coitus instrumentation vigorous exercises and awkward urethral irrigations predispose to the complication Urethral irritation and pain in the perineum radiating towards the anus scrotum and upper thighs are the usual complaints Urination is difficult and hindered by contraction of the external sphincter or the mechanical pressure of the swollen gland Defecation may be painful and associated with tenesmus

A swelling usually appears on one side of the perineum since bilateral involvement is very unusual An abscess develops and is manifest by a visible inflamed tender fluctuant mass appearing in front of the anus and extending toward the base of the scrotum The swelling may extend beyond the midline to the unaffected side Rectal examination with simultaneous digital palpation of the perineum often reveals the tender swelling to either side of the bulbomembranous urethra Chills and fever are usually present Fistula formation occurs in the neglected cases

Treatment—The patient is ordered to rest in bed and cold compresses are applied to the perineum main reliance is placed on the administration of *sulfathiazole* (p 88) or *penicillin* (p 106) Abscess formation requires incision and drainage A fistula is treated by excision and extirpation of the diseased gland

CHRONIC COWPERITIS

Chronic cowperitis is apt to pass unnoticed since it produces no complaints or findings unless there is suppuration of the gland fistula formation or a persistent and recurrent urethritis

The symptoms and physical findings resemble those of acute cowperitis except that the clinical picture is not so violent

Treatment of chronic cowperitis consists of application of heat administration of sulfonamides (p 88) or penicillin (p 106) and attempts to

clear the underlying urethritis Chronic suppurative cowperitis and fistula formation require surgical attention

TUBERCULOSIS OF THE BULBO URETHRAL GLANDS

Tuberculous cowperitis is rare and is usually secondary to a tuberculous urethritis (p 2337) The infection is conveyed by the urine The inflammatory process is usually confined to the gland but it may be diffuse and involve the periglandular tissue A chronic urethral discharge a perineal abscess or an indolent perineal fistula may originate from tuberculosis of Cowper s glands In any event the *diagnosis* is established by detection of the bacillus in the exudate or tissue

Surgical extirpation of the diseased gland and the fistulous tract are advocated Streptomycin therapy merits trial (p 103)

ACUTE PROSTATITIS

Primary acute prostatitis is a clinical entity that must be a rarity if it exists at all *Lymphogenous prostatitis* is also uncommon but *hematogenous infections* are encountered in the course of upper respiratory infections influenza pneumonia furunculosis typhoid fever smallpox parotitis and septicemia The remaining prostatic infections with few exceptions are due to the *gonococcus* and occur by way of the posterior urethra particularly as the result of unskillful or injudicious instrumentation or instillation In the rare instance of *nonspecific prostatitis*, of nongonorrheal origin the bacterial findings are conspicuously negative leading to the belief that the affection like nonspecific urethritis may be due to a virus In long standing cases of gonorrheal prostatitis the organism may not be demonstrable or it may be replaced or overgrown by secondary invaders

It is important for the practitioner to suspect gonorrheal participation in all examples of acute prostatitis but he must permit himself and his patient the reasonable doubt that the infection is of other etiology

Pathology—Acute prostatitis very early affects the glandular epithelium and lumina Acute catarrhal prostatitis is characterized by proliferation and desquamation of the epithelium with leukocytic infiltration As the process becomes advanced the lumina of the prostatic gland fill with a thick exudate of pus and epithelial cells With the formation of small abscesses the prostatitis assumes a follicular character until finally all the elements of the gland become involved producing a prostatic abscess or a parenchymatous prostatitis One lobe part of a lobe or the entire gland may be involved The catarrhal and follicular forms tend to resolve completely but the parenchymatous type usually terminates in contracture of the involved portion

Prostatic abscesses may spread to the bladder urethra and epididymis They may involve distant organs such as the joints and lungs or produce a fatal sepsis In more favorable examples they rupture into the rectum posterior urethra anus or perineum and produce fistulous communications or retention cysts

Clinical Manifestations—Acute prostatitis is suspected when the patient complains of pain in the perineum and rectum urinary frequency tenesmus or retention The rectal examination reveals swelling and tenderness of the prostate gland with purulent secretion The periprostatic tissues may be indurated and the periprostatic veins are often the site of a suppurative thrombophlebitis which leads to sepsis and pyemia

In the severer types of infection the temperature is elevated and toxic

constitutional manifestations develop The pain may radiate to the back or the posterior aspect of the thighs With the discharge of purulent material from the prostate the symptoms may diminish or subside

The prostatic abscess is accompanied by *pyrexia* and elevation of the pulse and respiratory rates *Chills* may so dominate the symptoms as to overshadow the local phenomena and create an erroneous impression of a sepsis of unknown etiology (p 32)

A prostatic abscess may rupture spontaneously into the posterior urethra rectum perineum or peritoneal cavity The former may be followed by recession of the symptoms the latter by death With rupture into the urethra or perineum the clinical course is most favorable Rupture into the rectum is not so satisfactory a termination since a recto urethral fistula usually develops with resultant complications such as pneumaturia

Treatment —The treatment of acute prostatitis should usually be conservative Hot sitz baths and rectal irrigations are used and streptomycin (p 104) with sulfonamide (p 88) or penicillin (p 106) is employed in large doses Chemotherapy is of inestimable value in the prevention and relief of the infection Massage of the prostate is best avoided by the practitioner since premature and rough manipulations favor extension of the infection into the periprostatic plexus A prostatic abscess should be incised and drained by the consultant urologist as soon as possible

CHRONIC PROSTATITIS

Chronic prostatitis is usually the result of acute infection of the gland which may or may not have been clinically apparent

Clinical Manifestations —Pain or a feeling of pressure in the perineum and rectum with frequency and urgency of urination are the usual symptoms of chronic prostatitis Less often the patient notes a weak stream periods of urinary retention sexual impotence poor erections premature ejaculations or prostatorrhea after urination or defecation Patients with chronic prostatitis are often regarded as sufferers from a sexual neurosis (p 1303)

Chronic prostatitis may exist for a long time without producing distressing symptoms but may produce recurrent attacks of epididymitis urinary tract infection or acute episodes of prostatitis

On rectal examination the prostate is but slightly enlarged and may even appear contracted or atrophic Its consistency is irregular and there may be soft depressions circumscribed by infiltrated areas Tenderness may be present The prostatic secretion contains pus bacteria epithelial and red blood cells but few or no lecithin granules The urine reveals shreds in the first and last specimens of the three glass test (p 3666)

Treatment —The underlying cause must be investigated and treated Distant foci of infection should be eradicated and local causes such as urethritis cystitis and stricture alleviated Despite the protracted course of these disturbances therapy with *sulfonamides* (p 88) or *penicillin* (p 106) and *streptomycin* (p 104) is often effective provided abscesses are drained and mechanical defects such as strictures corrected For local therapy posterior urethral instillations with 1 per cent protargol are advocated and irrigations of 1 5000 oxycyanide or mercury may also be effective Gentle but thorough massage of the prostate gland twice weekly should be at

tempted and prostatic diathermy hot sitz baths and hot rectal irrigations are sometimes advised Spicy foods alcoholic beverages and undue sexual stimulation should be avoided Chronically infected purulent cavities should be treated by perineal prostatomy and drainage

TUBERCULOSIS OF THE PROSTATE GLAND

The prostate gland appears to be more predisposed to hematogenous tuberculous involvement than any other urogenital organ The tubercle bacilli (p 252) may remain latent in the gland producing at most a mild catarrh until as the result of congestion following sexual intercourse a prostatic tuberculosis is inaugurated and soon spreads to the epididymis and seminal vesicles

Pathology—With the entrance of the tubercle bacillus into the prostatic gland, there is an initial desquamation of the lining epithelium The lumina become filled with masses of degenerated epithelial cells giant cells and tubercle bacilli The interstitial tissues are only slightly involved at this stage but later they become infiltrated with round cells epithelioid and giant cells Caseation occurs rapidly and abscesses form which rupture into the urethra, rectum or perineum There may be resorption of infiltrations and connective tissue formation with resultant contraction of the gland The contour of the gland then becomes irregular and hard in places A complete spontaneous healing of a tuberculous prostatitis is a rarity Within scarred areas there may remain virulent tubercle foci which institute an exacerbation or spread of the process on the slightest provocation

Clinical Manifestations—Prostatic tuberculosis may remain asymptomatic for long periods There may be no local complaints but only constitutional symptoms such as malaise fatigue night sweats anorexia and a low grade pyrexia *Miliary tuberculosis* (p 261) may have its origin in an unrecognized prostatic tuberculosis

When local symptoms develop they are similar to those of a nonspecific *prostatitis* (p 2470) The patient complains of pressure and discomfort in the perineum frequency and urgency of urination and terminal dysuria with radiation of pain to the tip of the penis There may be rectal tenesmus at the end of defecation or an early complaint may be terminal hematuria The urine is usually normal when the process has not involved the urinary organs but in most instances there is an albuminuria and small shreds are present in which tubercle bacilli may be found on miscroscopic examination Urethral discharge occurs only with rupture of a prostatic abscess into the urethra or in the presence of a urethritis Ejaculations are usually painful and may be bloodstained due to the complicating seminal vesiculitis Impotence is not infrequent Many of the symptoms of prostatic tuberculosis are due to the accompanying tuberculous involvement of the seminal vesicles bladder and urethra

On rectal examination the prostate gland is hard nodular infiltrated irregular and asymmetrical Induration of the periprostatic tissues is common Rupture of a prostatic abscess results in an area of softening

Course—Soon after the onset of prostatic tuberculosis foci occur in the seminal vesicles epididymis posterior urethra or urinary bladder The prostatic abscess may rupture into the rectum or perineum with resultant fistulous formation The healing of fistulas is rare and the outcome is generally downhill from multiple tuberculous foci and amyloid disease (p 7) Secondary invaders usually accelerate the local and general infection

Treatment—The local treatment of prostatic tuberculosis is symptomatic Spicy foods alcoholic drinks and all forms of stimulation which promote congestion should be prohibited and urethral instrumentation should be avoided Suppositories of belladonna and opium and hot sitz baths should be employed for relief of pain and tenesmus Methylene blue in 2 grain tablets is often prescribed three times a day Abscesses should be drained by aspiration and the cavities injected with iodide solutions (p 3824) As *prophylactic measures* tuberculous foci in the epididymides (p 2462) should be removed early in order to prevent involvement of the prostate gland Tuberculous patients must of course take special precautions against exposure to gonorrhea

Those who advocate radical surgery suggest total extirpation of the prostate gland seminal vesicles vas deferens and epididymis A course of streptomycin p 103) sulfonamides (p 88) or penicillin (p 106) may be of astounding benefit probably through control of secondary infection

SYPHILIS OF THE PROSTATE GLAND

There is no specific clinical picture characteristic of syphilis of the prostate gland Most often prostatitis in a syphilitic is the result of a concomitant *gonorrhea*

Syphilitic gummas of the organ have been described They are said to cause dysuria hematuria and an enlargement of the gland which may be difficult to differentiate from prostatic hypertrophy or carcinoma The therapeutic test with iodide is the only certain diagnostic aid since serologic tests may be positive also in a syphilitic with benign prostatic hypertrophy or carcinoma

ACTINOMYCOSIS AND BILHARZIASIS OF THE PROSTATE GLAND

Actinomycosis (p 489) and bilharziasis (p 537) of the prostate gland occur in association with bladder involvement The manifestations are predominantly referable to the cystitis (p 2343) The *diagnosis* is established by demonstration of the causative organism in the local secretions.

THE CLINICAL DISTURBANCES OF THE MALE BREAST

The male breast is an atrophic structure yet it may exhibit the same clinical abnormalities as the female breast (p 2579) *Accessory nipples* may be found along the mammary ridge which extends from the mid clavicular line to the inguinal region Quite frequently *sebaceous cysts* and *cystadenomas* are observed and require no attention unless they ulcerate or show evidences of growth

Malignant lesion of the male breast (p 2581) is an unusual clinical incident but must be suspected if the tissue becomes indurated ulcerated or evidences growth Finally a dislocation of the androgen estrogen ratio (p 2418) results in the feminization of the male breast producing the condition of *gynecomastia* This is observed in secondary *hypogonadism* (p 2413) particularly of anterior pituitary origin and with *chorionepitheliomas* of the testis (p 2442) which produce excessive amounts of gonadotropic substance as well as estrogen

SECTION XVI

THE FEMALE REPRODUCTIVE SYSTEM

Associate Editor ERIC MATSNER M D

CHAPTER 118

PHYSIOLOGY METHODS OF DIAGNOSIS AND TREATMENT

THE female reproductive system has internal secretory gonadogenic and copulative functions Besides the hormonal secretions of *estrogen* and *progesterone* the ovaries produce an egg each lunar month The primordial cell travels to the uterus and through the fallopian tube during the active sex life of the female fertilization may follow copulation and ejaculation by which means myriads of spermatozoa are deposited intravaginally

Ovulation is followed by sloughing of uterine mucous membrane manifested by *menstruation* Should the ovum be fertilized a *placenta* is formed uniting vascular structures of mother and child Following the period of gestation the amazing phenomena of *parturition* are initiated Fetus and placenta are expelled the child initiates its independent existence and the mother enters her *puerperium* continuing to nurture her infant through mammary secretions

Disturbances of the female generative system are vastly more complex than those of the male They constitute an important portion of the daily routine of the practitioner The present chapters are concerned with the physiologic and pathologic processes of woman particularly in relation to pregnancy delivery the puerperium and lactation Since most physicians engage in obstetrics and the care of the newborn special but necessarily brief consideration is given these important topics

ANATOMY

See page 3641

PHYSIOLOGY

The normal female passes through recognizable phases of prepuberty puberty adolescence maturity menopause and post menopause During these epochs she produces the internal secretory products of estrogen and progesterone Upon exposure to impregnation under normal conditions she and her sexual partner fulfill their procreative functions unless contraceptive practices are instituted Unlike her male associate her future life is altered by pregnancy since she carries and nurtures her fetus delivers her baby suckles it and cares for it during its early formative years A review of the normal physiology of these epochs is a necessary basis for the recognition and management of disturbances and abnormalities of the female generative organs

INTERNAL SECRETORY FUNCTIONS

Under the stimulus of the gonadotropic factors of the anterior pituitary gland the ovaries secrete *estrogen* (p 2515) and *progesterone* (p 2517) *Androgenic substances* and *17 ketosteroids* also are demonstrable in female biological fluids

Among the clinical manifestations of the complex endocrinologic derangements are *hypogonadism pubertas praecox virilism* or *masculinization* and perhaps *acne vulgaris* The hormonal activities of the *placenta* are described in the chapter on *Pregnancy* (p 2617)

PREPUBERAL GROWTH AND DEVELOPMENT

In the newborn female sudden withdrawal of maternal hormones often results in a scanty bloody *vaginal discharge* (p 2778) accompanied by hyperplasia of the breasts from which colostrum may be expressed (witches milk) estrogenic hormone may be found in the infant s urine until the fourth postpartum day

Uterus fallopian tubes and ovaries lie within the pelvic inlet and do not enter the true pelvis until puberty The uterus is small the cervix about twice as long as the body of the organ and the tubes are long and convoluted As the child grows uterine body and cervix become equal in size and in the mature female the body is double the size of the cervix A long narrow cervix and a retroverted uterus are characteristics of *prepuberal hypogonadism* in the female (p 2523)

About the eighth year the female child enters upon a new phase of sexual growth and differentiation The pelvis becomes wider and fat deposits appear on the hips breasts and pubis there is rapid increase in somatic growth which continues with the onset of puberty The entire prepuberal period is predominantly one of somatic growth and development The reproductive system shares in the general growth impulse but the reproductive function remains in abeyance There is little or no gonadotropic or estrogenic hormone in the urine

During this period disease of the reproductive organs is rare The chief gynecologic problems are *congenital abnormalities* rare *neoplasms* of the *ovaries* and *gonococcal vulvovaginitis* Occasionally *pubertas praecox* characterized by the premature onset of adult sexual characteristics is encountered (p 2527)

PUBERTY AND ADOLESCENCE

Puberty marks the beginning of the adult phase of reproductive function It is a period of intense glandular upheaval leading to the attainment of a new hormonal equilibrium The occurrence of puberty is foreshadowed by the appearance of estrogenic hormone in the urine Cyclic variations in hormone excretion are noted for several months before actual menstruation The chief clinical features of puberty are the appearance of adult secondary sexual characteristics the little girl develops pubic hair fullness of the breasts and widening of the hips the attainment of full gonadal function slows the rate of somatic growth and leads to closure of the epiphyses of the long bones

DIFFERENTIAL DIAGNOSIS OF *Prepuberal Bleeding*

Prepuberal vaginal bleeding is physiologic in the first few days of the life of the infant There after it has serious pathologic significance

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Neonatal	Slight to moderate bloody discharge From maternal estrogen.
Neoplastic	Granulosa tumor or dermoid of ovary (p 2573) Palpate by rectum. Consider laparotomy
Traumatic	Particularly wounds of impalement. Repair lacerations Give anti-gas gangrene serum and penicillin (p 300)
Hemorrhagic Diatheses	Particularly hemorrhagic disease of newborn with therapeutic response to menadione (p 1113) Erythroblastosis foetalis with characteristic hemogram and Rh finding in maternal and paternal bloods (p 1067) Scurvy with therapeutic response to cevitamic acid (p 1121) Leukemias and thrombocytopenias with pathognomonic hemogram (p 3704)

THE MENARCHE

The advent of menstruation heralds the beginning of adolescence Among American girls the onset of menstruation occurs from the eleventh to the sixteenth years The average age of its first occurrence is thirteen Constitutional hereditary geographic and racial factors determine to some extent individual variations in the time of onset Failure of appearance of the first menstruation by the age of fifteen is an indication for investigation (p 2494)

At the menarche the young female assumes adult proportions Voice face and figure mature external and internal genitalia enlarge and a normal heterosexual libido is aroused The little girl is transformed into a young lady Ovulation may not occur simultaneously with the onset of menstruation a period of ripening of one to two years may be required after the onset of menstruation before the capacity for reproduction is fully developed

DIFFERENTIAL DIAGNOSIS OF

Abnormalities of Sexual Development

Sexual development is dependent upon a sensitive endocrine balance that is established between gonads (ovaries or testes) and anterior pituitary adrenal cortical, thyroid and pineal glands Disturbances may be manifested by delayed or premature sexual development accelerated decrescence the onset of the physiologic menopause or climacteric, masculinization of the female or feminization of the male

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Retardation	
Prepubertal Hypogonadism	With infantilism and primary amenorrhea (p 2518) Note therapeutic response to estrogen (p 2515)
Albright s Syndrome	With dwarfism premature senility (progeria) osteoporosis and congenital abnormalities (p 2524) Try estrogen therapy
Hypopituitarism	Levi Lorain type of proportional dwarfism (p 1164) Try anterior pituitary extract (p 1154)
Dyspituitarism	Fröhlich type of dwarfism with obesity (p 1166) Try anterior pituitary and thyroid extract (p 1154)
Laurence Moon Biedl Syndrome	Dwarfism with polydactylism, retinitis pigmentosa and mental deficiency (p 1166) Try anterior pituitary extracts (p 1154)
Hypothyroidism	Cretinous dwarfism with obesity and low B M.R. Note therapeutic response to thyroid extract.
Pancreatic Infantilism	Infantilism associated with intestinal indigestion Use high protein diet and pancreatic extracts (p 1936)
Precocity (Pubertas Praecox)	
Granulosa and Theca Cell Ovarian Neoplasms	Ovarian tumor Consider laparotomy
Hyperpituitarism	Early stages of giantism and acromegaly Note increased stature X ray sella turcica and consult neurosurgeon
Pinealoma	With macrogenitosomia praecox (p 1185) X ray skull and consult neurosurgeon
Neoplastic and Inflammatory Lesions of Hypothalamus and Third Ventricle	With evidences of increased intracranial pressure (p 1468) Refer to neurosurgeon for neurologic survey ophthalmoscopy x ray studies lumbar puncture and craniotomy
Early Climacteric	
In the Female	Following bilateral oophorectomy or atrophy of ovary due to inflammation, cachexia or irradiation Give estrogen (p 2515)
In the Male	Following bilateral orchidectomy or atrophy of the testes due to inflammation cachexia or irradiation Give androgen (p 2401)
Rejuvenation Following Menopause	
Granulosa and Theca Cell Ovarian Neoplasm	Ovarian tumor palpable by pelvic examination Consider laparotomy

CONTINUED

Masculinization of the Female	
Physiologic	At the menopause
Dislocation of Androgen-estrogen Ratio	May be associated with acne vulgaris and aberrations in sexuality
Arrhenoblastoma or Adrenal Rest Tumor of Ovary	Mass palpable on pelvic examination Advise laparotomy
Chromophobe Adenoma Sarcoma or Erdheim Tumor of Pituitary	With enlarged sella turcica optic atrophy and evidences of increased intracranial pressure Refer to neurosurgeon for decision as to craniotomy or x ray treatment (p 1175)
Pituitary Basophilism	Cushing syndrome of obesity hypertension and abdominal striae Look for enlarged sella turcica or evidences of adrenal cortical neoplasm Consider surgery
Adrenal Cortical Tumor	With hypertension Note deformities on perirenal insufflation (p 224.) Advise surgery
Thymoma	Widening of mediastinum on x ray Consider surgery or x ray therapy (p 1236)
Hermaphroditism	Changes in external and internal genitals Make hormone assays (p 2531)
Feminization of the Male	
Male Climacteric	With symptoms similar to those of female menopause Note effects of androgen (p 2412)
Dislocation of the Androgen-estrogen Ratio	May be associated with aberrations in sexuality (p 2412)
Hypopituitarism	May be manifest as eunuchoid giantism or as Simmonds disease with cachexia hypotension and diminution of B.M.R. (p 1169) X ray sella and refer to neurosurgeon.
Hypogonadism	Usually prepuberal and associated with cryptorchidism Administer androgen and/or gonadotropin (p 2412)
Dyspituitarism	With obesity as in Frohlich syndrome (p 1166) Try anterior pituitary and thyroid extracts

Gynecologic disorders are common at this time They include *menstrual irregularities* (p 2618) *dysmenorrhea* and *delayed development Endocrine dyscrasias* (p 1144) are frequently encountered There is a peak in the incidence of *diabetes mellitus Hyperthyroidism* is occasionally seen and the effects of *hypogonadism* (p 2523) become manifest

SEXUAL MATURITY

During the period of sexual maturity which spans the years between menarche and menopause menstruation occurs with variable regularity The menstrual flow is of three to seven days duration with an average of four days The cycle averages twenty eight days from the first day of one menstruation to the onset of the next bleeding Variations are common from month to month and from individual to individual

Sexual maturity is modified by exposure to impregnation and gravidity Few women escape some clinical derangement during the era of active

sex life, *menstrual disorders* wanted and unwanted *pregnancies sterility* abnormalities of *lactation disturbances of parturition birth injuries infections* of venereal and non venereal origin and *neoplasms* claim attention at one time or another

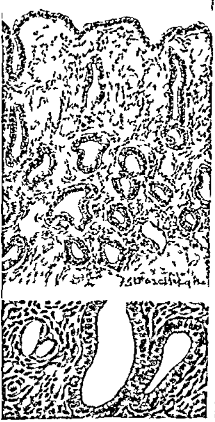


Fig 591



Fig 592

Fig 591 —Early estrogenic phase (regeneration and proliferation)
Fig 592 —Late estrogenic or proliferative phase

MENSTRUATION AND THE MENSTRUAL CYCLE

The endometrium of the mature uterus undergoes cyclic structural changes in response to variations in the production of estrogen and pro

* Curtis Textbook of Gynecology



Fig 593



Fig 94

Fig 593—Secretory phase (estrogen and progestin)
Fig 594—Menstrual phase

gesterone The monthly period involves a phase of growth and glandular development In the absence of fertilization separation and endometrial

* Curti, Textbook of Gynecology

degeneration is reflected by the bloody vaginal discharge of menstruation which is attended by widespread changes in breasts, internal secretions, blood and metabolic functions

Endometrial Changes —Proliferative secretory and menstrual phases are noted in the endometrium during the menstrual cycle The *proliferative phase* which results from estrogenic stimulation, begins at the end of the preceding menstrual phase and continues until the time of ovulation It is characterized by progressive growth of the endometrium which increases in thickness while its glands become elongated and tortuous and the stroma shows much mitotic activity

The *secretory phase* develops under the predominating influence of progesterone With the occurrence of ovulation usually from the tenth to the sixteenth day of a twenty eight day cycle, the endometrium continues to grow the mucous membrane doubles in thickness the glands dilate and develop papillary projections into the lumina, the nuclei assume a basal location due to filling of the cells with glycogen and the stroma cells enlarge and appear compact in the superficial zone while they are separated by edema fluid in the deeper spongy layer Shortly before the menstrual phase stroma cells become decidual in appearance, and there is increased congestion and leukocytic infiltration If ovulation does not occur there is a phase of waning hyperplasia due to a diminishing concentration of estrogen this eventually results in bleeding

The *menstrual phase* is marked by an extravasation of blood into the stroma and desquamation of spongy and compact endometrial layers The onset of menstruation is associated with an acute reduction in the blood level of progesterone The escape of blood is preceded by stasis in the endometrial arterioles and local vasoconstriction followed by vasodilatation and bleeding Hematomas form beneath the epithelium the necrosis and shedding of which begin at the end of the first day Other coiled arteries begin to bleed at subsequent intervals repeating the process in different areas so that at the end of three or four days the uterine mucosa is almost completely denuded

The Menstrual Flow —The menstrual flow at first is usually scanty and white but within twenty four hours it becomes serosanguineous The greatest flow is reached at the end of the second day Although menstrual blood is not coagulable occasional small clots are observed even in the normal individual As the flow subsides it becomes serosanguineous and finally mucoid The amount of blood lost averages 60 cc with a variation of 20 to 100 cc

Tubal and Myometrial Changes —Cyclic variations occur in the irritability and contractility of uterine and tubal musculature In the estrogenic phase the uterine musculature is actively motile and is sensitive to the action of oxytocic drugs such as posterior pituitary extract During the luteal phase motility ceases and the muscle is relatively refractory to stimulation due to the sedative effect of progesterone The inhibitory progesterone influence is removed one or two days before the onset of menstruation coinciding with the onset of premenstrual cramps See *Dysmenorrhea* (p 2561)

Changes in the Breasts —Cyclic changes in the mammary glands take place during the menstrual epoch, in response to hormone stimulation

Estrogen promotes the growth of the mammary ducts progesterone stimulates the development of secretory tissue in preparation for lactation which in turn is induced by pituitary prolactin At the time of menstruation the breasts show maximum development in some women milk is secreted regularly during menstruation or at periodic intervals in place of menstruation However estrogenic and progestational influences are not necessary for the continuation of lactation which may persist after the menopause and oophorectomy

Metabolic Changes —During the various phases of the menstrual cycle fluctuations in organic and inorganic metabolism are reflected by alterations of the chemical composition of blood and urine During the intermenstrual period there is a decreased urinary excretion of sodium chloride and water accompanied by gain in weight and the development of *menstrual edema* With the onset of menstruation the urinary excretion of these substances increases with relief of edema and loss in weight Excessive creatinuria has been observed during the menstrual period the resistance to insulin increases and the carbohydrate tolerance of diabetics is decreased

Hematologic Changes —A fall in the concentration of blood platelets has been observed during menstruation and many women bruise more easily There may be slight leukopenia and an increased susceptibility to *agranulocytosis* The loss of blood during menstruation aggravates any tendency to *iron deficiency anemia* and is an important contributory factor in *chlorosis* During intensive arsenotherapy of syphilis the ominous treatment complication of hemorrhagic encephalopathy occurred disproportionately in women treated during menstruation suggesting a transitory sensitivity associated with glandular changes

Hormonal Variations During the Cycle —The rate of urinary excretion of *estrogen* during the menstrual cycle is greatest at the time of ovulation and just before the onset of menstruation As these peaks are associated with increases in blood levels there must be increased production of the hormone See *Changes in Basal Temperature* (p 2628)

The blood concentrations of *progesterone* are indicated roughly by the rate of urinary excretion of sodium pregnandiol glucuronide This substance the excretion form of progesterone appears in the urine at the time of ovulation and disappears at the onset of menstruation Complete information is not yet available as to the sources and variations in the economy of androgen and 17 ketosteroids in the female There is a suggestion that they are related to adrenal cortical function

Menstrual Molimina and Premenstrual Tension —It is the rare exception for the phenomenon of menstruation to be limited to uterine bleeding Most women experience an individual fairly constant symptom complex at the time of the flow These *menstrual molimina* may consist of headache malaise lassitude pains in the back and legs sensations of heat flushes chilliness abdominal cramps bladder irritability and urinary frequency Cramps may be so severe that the patient is confined to bed for the first two or three days of the bleeding Backache may be troublesome and incapacitating Psychic depression capriciousness and nervous irritability are observed Some women become listless while others suffer from restlessness there may be extreme sexual desire or marked revulsion

Many women secrete a *menotoxin* which produces a characteristic odor and causes flowers worn as corsages to wilt

The subjective manifestations are accompanied by a recurrent pattern of objective changes The *breasts* are usually tender and often engorged *dermatoses* particularly urticaria acne and atopic skin eruptions increase in incidence and severity there is a tendency to *easy bruising* due to an increase in capillary fragility and changes in the hemogram the *pulse rate* increases, *blood pressure* tends to rise and *body temperature* is slightly elevated above normal, the *external genitalia* appear engorged and succulent, *cervix* and *vagina* are greatly relaxed and the *ovary* containing the corpus luteum is often palpable The *thyroid* is visibly enlarged, *body weight* increases due in large part, to retention of fluid as manifest by the appearance of a demonstrable edema

Treatment—The discomforts associated with menstruation are combated by psychologic and pharmacologic modalities

PROPHYLACTIC PSYCHOTHERAPY—The psychologic aspects of therapy are important at the menarche The pre adolescent should be prepared for the appearance of the first period To the unprepared girl menstruation may prove a shocking experience and may initiate abnormal attitudes toward sex which lead to psychiatric disturbances in later life The normal physiological function of menstruation should be explained the hygiene of menstruation should be outlined the little girl should be reassured that menstrual molimina are not detectable, that the menstrual period need make no change in her normal daily routine and that bath and showers are permissible throughout the flow

RELIEF OF PREMENSTRUAL TENSION—Those who develop the syndrome of premenstrual tension with significant edema weight gain engorgement of the breasts malaise and discomfort in the lower abdomen are most effectually relieved by preliminary dehydration For two days preceding the expected period and during the first two days of the flow a dry diet (p 664) is suggested and salt is avoided in cooking and at table Compressed tablets of ammonium chloride 0 5 gm (7½ grains) are given during the four days to make a daily total of 4 to 6 gm (60 to 90 grains) In refractory instances the routine may be supplemented by daily injections of 1 mg of *progesterone* (p 2517)

Injections of 10 to 25 mg of androgen also may be tried on the tenth and third days preceding the expected period Those women who cannot receive injections may be treated by daily oral doses of 10 mg for the ten days preceding the expected period

ALLEVIATION OF CRAMPS—Menstrual cramps are usually alleviated by *acetylsalicylic acid* given in doses of 0 3 to 1 0 gm (5 to 15 grains) To the analgesic may be added a sedative in the form of *sodium phenobarbital* 15 mg (¼ grain) and an *antispasmodic* such as Syntropan N N R (50 mg or ¾ grain) or pavatrin (120 mg or 2 grains)

A prescription which incorporates all three principles is as follows

℞		
	Acetylsalicylic acid	5 0
	Sodium phenobarbital	0.25
	Syntropan	0 5
	Divide and make into 15 capsules	
	Sig One every 3 hours as directed	

More severe or persistent menstrual pain requires *stronger remedies* and to the preparations mentioned above are added *demerol* 50 *mg* (¾ grain) *or codeine phosphate* 15 mg (¼ grain) remembering that each of the latter requires a narcotic prescription. Finally, after explanation to the women of the dangers of masculinizing manifestations, 100 to 150 mg of *androgen* (p. 2404) are given by intramuscular injection using 25 mg doses daily beginning not later than the sixth day of the cycle.

Many women use alcohol in the form of gin or as "female remedies" of high alcoholic content. This practice is discouraged since a fair proportion of female alcoholics attribute habituation to this custom.

In extreme instances it may be necessary to advise *roentgen castration or hysterectomy* particularly *in* endometriosis (p. 2558) *occurring at or near the menopause.*

Vicarious Menstruation.—Extra uterine bleeding occurring at the time of the expected menstrual period is a rare phenomenon. Vicarious menstruation is said to exist if bleeding occurs from mouth, nose or rectum in the absence of vaginal bleeding. The occurrence of vicarious menstruation is denied by many but vascular changes are demonstrable in the nasal mucosa as a result of estrogen and progesterone stimulation.

Hygiene of Menstruation.—The introduction of lightweight sterile *inexpensive cellulose sanitary pads* has greatly *simplified the hygiene of the menstrual period. Intravaginal tampons* have *increased in* popularity during the past few years. Intravaginal pads must be changed frequently for they favor retention of secretion and may invite infection.

There is no reason why women should not continue their normal habits of life and employment during menstruation provided they are free from marked subjective discomfort. *Simple exercise* is encouraged but *swimming* in cold water and strenuous exertion may cause pelvic discomfort. *Tub baths* are permitted unless they *produce excessive flow; warm showers* during the period are wholly salutary. *Sexual intercourse is* devoid of danger but is discouraged on aesthetic grounds.

OVULATION

One or two years after the onset of the menses the ovulatory function of the ovary becomes fully established and conception is possible. Ovulation and menstruation though interdependent are distinct processes. Menstruation can *occur in the absence of ovulation* (anovulatory menses) *and* ovulation with conception *may occur in a female who has never* menstruated.

Oogenesis.—At birth each ovary contains its full complement of many thousand primitive ova. *Many of these undergo* partial maturation and subsequent regression during childhood. Of the thousands present at puberty only a few hundred are liberated as mature ova during the period of sexual activity *between menarche and* menopause. The fertile life span of a woman is 25 to 30 years. About 300 to 400 ova *may* develop to maturity for potential fertilization. This is in marked contrast to the 200 to 500 million sperm in a single male ejaculation.

Each primitive follicle consists of a round *oocyte* surrounded by a single layer of flattened epithelial cells. At puberty in response to the follicle stimulating hormone of the anterior pituitary gland at least one

primitive follicle becomes a mature ovum and is released by ovulation Several follicles share in the growth stimulus but as a rule only one progresses to complete *maturation*

As the follicle matures the ovum enlarges and becomes surrounded by the *zona pellucida* a thin clear membrane The single layer of flattened epithelial cells gives rise to a stratified cuboidal epithelium the *zona granulosa* which secretes a follicular fluid and forms a small vesicle the *graafian*

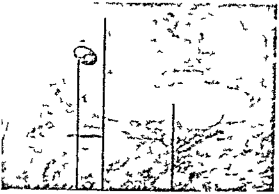


Fig 595 —Section through ovary *1* Developing Graafian follicle *2* Ovarian cortex *3* Old corpus luteum (corpus albicans)

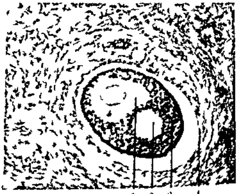


Fig 596 —Developing Graafian follicle × 112 *1* Antrum with liquor folliculi *2* Ovum *3* Follicular epithelium *4* Theca of follicle

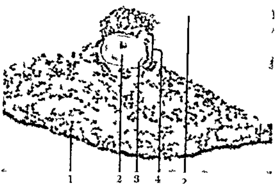


Fig 597 —Maturing Graafian follicle × 112 *1* Stratum granulosum *2* Ovum *3* Zona pellucida *4* Cumulus oophorus *5* Cavity filled by liquor folliculi

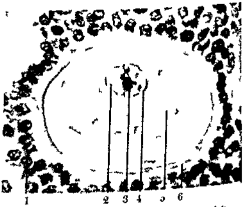


Fig 598 —The ovum of follicle at left, magnified * × 500 *1* Cells of follicular epithelium *2* Egg nucleus or germinal vesicle *3* Nucleolus *4* Nuclear membrane *5* Yolk particles *6* Zona pellucida

follicle This structure pushes the ovum to one side where it becomes imbedded in a mass of follicular cells the *discus proligerus* The circumfollicular connective tissue differentiates into two layers the *theca interna* is in contact with the basement membrane of the follicular cells and the *theca externa* merges with ovarian stroma These layers are concerned with the subsequent formation of the *corpus luteum* As the follicle grows it becomes distended with fluid and gradually approaches the surface of

* Courtesy of Ortho Products Inc

the ovary An avascular area appears on the surface and with the rup ture of the follicle the ovum is swept out to enter the tubal infundibulum The exact mechanism of follicular rupture is unknown As the follicle grows it produces its specific *estrogenic hormone*

Migration of the Ovum—Upon entering the fallopian tube the ovum is swept along by the peristaltic activity of the tube and to a lesser de gree by the motion of the cilia Fertilization usually occurs in the tube and the fertilized ovum migrates slowly into the uterine cavity See *Ectopic Gestation* (p 2657)

The Corpus Luteum —After ovulation the follicle gives rise to the *corpus luteum* an endocrine gland which is the source of *progesterone* in the nonpregnant female and during the first trimester of pregnancy The gran ulosa cells lining the collapsed follicular cavity proliferate and enlarge to form polygonal follicular luteum cells Meanwhile cells of the theca in terna penetrate the follicle and produce smaller *theca luteum* elements The mature corpus has a festooned or corrugated outline and its bright yellow color is due to the presence of large amounts of cellular carotene It is highly vascular as a result of the ingrowth of delicate blood vessels from the theca interna

The Corpus Luteum of Pregnancy—The subsequent history of the ovum after ovulation determines the fate of the corpus luteum If the ovum is fertilized there is formed the enlarged *corpus luteum of preg nancy* with a central cystic cavity and a broad zone of luteum cells arranged in fascicular strands that resemble the structure of the adrenal cortex The corpus continues to grow until the fourth month of gestation and then slowly regresses

The Corpus Albicans—If fertilization does not occur the corpus luteum begins to degenerate after a brief period of activity The luteum cells be come small and vascularity is lost A small convoluted *corpus albicans* is finally formed after several months have elapsed On cross section a nor mal ovary may show several corpora lutea in various stages of regression

Clinical Disturbances of Ovulation —The majority of women experience no subjective or objective manifestations at the time of ovulation In many women however there are characteristic signs that recur with each ovulation Extremely common is a *dragging dull ache* in one of the lower quadrants of the abdomen This may last for twelve to twenty four hours from the tenth to the sixteenth day of the menstrual cycle and tends to lower quadrants A slight left alternate each month between right and bloody *vaginal discharge* at this time is also common and may last from two to four days ovulation bleeding has been ascribed to a sudden reduc tion in the production of estrogen Other phenomena associated with ovu lation are a physiological discharge of white mucoid secretion from the cervical glands painful sensitive breasts and an increase in sexual appetite corresponding to heat in lower animals The latter may be a mechanism to stimulate fecundity and insure fertilization of the extruded ovum

See *Fertilization* (p 2491) *Contraception* (p 2502) *Dysovulation* (p 2528) *Changes in Basal Temperature* (p 2628) *Infertility* (p 2492)

Time of Ovulation —Ovulation normally occurs fourteen to fifteen days before the onset of the next expected period With the normal twenty eight day cycle ovulation takes place between the tenth and sixteenth days fol

lowing the onset of the menses Patients who are anxious to conceive are therefore urged to have sexual intercourse regularly during this fertile period The days preceding and following the so called fertile period are referred to as the safe period These latter are frequently utilized for contraceptive purposes It should be noted however that conception has frequently occurred during the safe period

SEXUAL INTERCOURSE IN THE FEMALE

The female genital tract functions for sexual and reproductive purposes The sexual aspect constitutes a biological lure for the perpetuation of the race Sexual intercourse in the female involves phases of *erection orgasm* and *detumescence* just as in the male Until recent times this similarity was not stressed Through the Victorian era it was the tacit understanding that the female played a passive and merely receptive role during intercourse Undoubtedly this misconception was responsible in no small manner for the neuroses that were so rife during that period The present era of the liberation and emancipation of woman has been characterized among other things by the recognition that the female experiences the same sensory manifestations in intercourse and is entitled to the same sexual satisfaction as her male partner

Erection—Erection of the clitoris is a reflex response to stimuli of psychogenic or local origin The genital erogenous structures are clitoris and vagina including cervix There is marked individual variation in the sensitiveness of these areas Complete sexual gratification is achieved by most women, only through sexual intercourse If vaginal sensation is absent digital stimulation of the clitoris before during or following intercourse is necessary to achieve an orgasm

The mechanism of erection of the clitoris the homologue of the penis is accomplished through the erigens nerves The arterioles of the erectile tissue are dilated producing a local increase of blood supply Simultaneously there is a partial occlusion of venous outflow Associated with vascular changes Bartholin glands secrete a lubricating fluid which facilitates penetration by the male organ

Penetration and Orgasm—Under normal circumstances the vagina is entered along the posterior wall Awkwardness and haste resulting in penetration along the anterior wall are apt to produce trauma to the urethra, and resultant *dyspareunia* (p 2491) When the vagina has been penetrated the penis is clasped by the constrictor muscles and *held* until orgasm occurs The experienced woman skilfully controls these sphincteric mechanisms 'cum lege artis'

In the expertly contrived sexual congress male and female orgasms occur simultaneously the sperm is forcibly ejected through the male urethra while contractions are occurring in the musculature of tubes and uterus The considerate and experienced male controls ejaculation until his partner slower to react approaches her climax

Detumescence—At the termination of orgasm detumescence occurs This phase is accompanied by a glow of satisfaction and a release from tension Errors in timing result in premature orgasm by the male and dissatisfaction, irritability and finally frigidity on the part of the woman.

FERTILIZATION

Fertilization of the human ovum probably takes place in the outer end of the fallopian tube and less frequently in the ovary In normal preg nancy the fertilized ovum makes its way to the uterine cavity where nidation occurs Under pathologic circumstances the fertilized ovum fails to migrate and produces an ectopic pregnancy

During sexual congress spermatozoa swim through vagina cervical canal and the lumen of the uterus to meet the maternal germ cell in the ampulla of the fallopian tube When the successful spermatozoon reaches

DIFFERENTIAL DIAGNOSIS OF

Disturbances of Female Sexuality

The majority of disturbances of sexuality in the female are of psychogenic origin. Dyspareunia *however is often due to technical or organic causes and is responsive to intelligent therapy*

CLINICAL MANIFESTATIONS	AND DIAGNOSTIC FEATURES
Increased Libido (Nymphomania)	Psychogenic Following prolonged continence At menopause when there is no longer fear *of pregnancy With agitated psychoses With* endocrinopathies productive of precocity
Decreased Libido (Frigidity)	Psychogenic At menopause when sex instinct is held repulsive With endocrinopathies productive of sexual infantilism and retardation. Try estrogen or androgen therapy (p 2515) In association with dyspareunia With relaxation and laceration of perineum, abnormalities of clitoris prolapse of cervix, vaginal fistulas and anorectal lesions Refer to gynecologist for reparative surgery
Abnormalities of Libido (Homosexuality Lesbianism)	Psychogenic Dislocation of androgen-estrogen ratio (p 2527)
Dyspareunia	*Psychogenic Of technical origin due to* awkwardness lack of lubrication or trauma (p 2490) Following menstruation Of genital *origin, due to rigidity of hymen, vaginismus* kraurosis vulvae vulvitis bartholinitis vaginitis oophoritis salpingitis cervicitis or endocervicitis *Refer to gynecologist for local treat*ment Of rectal origin due to hemorrhoids fissures or fistulas Of urinary origin due to urethral caruncle or urethritis *Treat locally*

the ovum it becomes incorporated into the female cell by a process that simulates phagocytosis This biological phenomenon is not wholly unlike *the marital absorption of the recessive male by his dominant spouse! Dur*ing absorption of the spermatozoon the tail is lost and the cell becomes rounded and fuses with the ovum to create a new individual

The Time of Fertility—Spermatozoa may retain motility in the normal vagina for three hours in the cervical canal for seven hours and within the *uterus for twenty five hours* The exact *life* span of the human ovum following its release from the ovary by ovulation is not known but it is be-

DIFFERENTIAL DIAGNOSIS OF

Female Infertility

Infertility or sterility is conveniently defined as a failure to conceive despite repeated sexual intercourse during a period of two to three years If there have been adequate opportunities for impregnation, and sexual intercourse has been satisfactorily consummated, the status of each partner is subjected to scrutiny In most instances the practitioner is equipped to solve satisfactorily those examples of sterility that are capable of correction. Curtis has summarized his views by stating that the practitioner may learn to care for his sterile and low fertility patients with results closely rivalling those of his highly specialized confreres. When the physician has exhausted his resources however he should seek specialist consultation

The disturbances of fertility include infertility sterility abortion (p 2649) stillbirth (p 2787) and prematurity (p 2763) The causes of these disorders are equally divided between the sexes hence it is necessary to examine both marital partners in the investigation of the difficulty

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Disturbances of Sexual Intercourse	See p 2490 with particular reference to period of vulnerability
Male Infertility	See p 2419
Hermaphroditism	See p 2531
Psychogenic	Profound emotional shocks or conflicts resulting in abortion, stillbirth or prematurity
Systemic Infection	Mumps with complicating oophoritis (p 2612) Syphilis with positive serology or cerebrospinal fluid (p 331) Lymphopathia venereum with positive Frei test (p 473) Gonorrheal invasion with fixation of complement (p 221) Genital tuberculosis (p 2610)
Mechanical and Physical	Particularly local instrumentation causing abortion. Following x ray treatment. Post abortal Following ligation of tubes Post oophorectomy salingectomy or hysterectomy
Neoplastic	Masculinizing tumors of ovaries anterior pituitary thymus or adrenal cortex (p 2481) Consider surgery
Metabolic Disturbances	Profound cachexias. Marked obesity Uncontrolled diabetes mellitus Avitaminoses Nausea and vomiting of pregnancy Hypertensive toxemia of pregnancy causing abortion, stillbirth or prematurity
Endocrinopathies	Hypogonadism with therapeutic response to estrogen or gonadotropin (p 2523) Progesterone deficiency causing habitual abortion, note response to progesterone (p 2653) Hypothyroidism with low B M.R. and response to thyroid extract. Hypopituitarism. Note effects of anterior pituitary extracts and gonadotropins (p 1154)
Hematologic Disturbances	Profound anemias Check hemogram and give hematinics antianemic principles or transfusions (p 3709) Hemolysis due to iso-agglutinins as in erythroblastosis foetalis Check Rh factors in maternal and paternal bloods (p 1067)

CONTINUED

Gynecologic	Imperforate hymen. Vulvitis Vaginitis Stenosis neoplasm, ulceration, erosion or polyposis of cervix. Uterine displacements (p 2537) Endometritis (p 2606) Uterine tumor Salpingo-oophoritis Stenosis of tubes Ovarian cyst or tumor (p 2564) Endometriosis (p 2558) Pelvic peritonitis (p 2604) Supplement *gynecologic survey* with uterine insufflation and diagnostic curettage Treat locally and consider reparative surgery
Placental	Placenta praevia or premature detachment resulting in stillbirth or prematurity (p 2661) Refer to obstetrician
Amnion	Hydramnios or oligo-amnios resulting in still birth, fetal death or prematurity (p 2668)
Fetal	Fetal death Monstrosity causing abortion or prematurity Erythroblastosis foetalis due to Rh disturbances of maternal and paternal bloods (p 1067)
Unknown	Low fertility index.

lieved limited to only a few hours Thus the opportunity for fertilization each month is extremely limited and if fertilization does not occur the ovum undergoes degenerative changes

Ovulation normally precedes menstruation by fourteen to fifteen days The time of ovulation therefore in a woman with a twenty eight day cycle occurs midway between the first day of the last menstrual period and the first day of the expected menstrual period Allowing for variation in the time of ovulation the fertile period occurs from the tenth to the sixteenth days following the onset of the last menses In calculating the fertile period for women having a non twenty eight day cycle the date of the next expected period is recorded and fourteen days are counted back from this date This day the two days preceding and the two days following are assumed to be the fertile period Patients who are anxious to conceive are advised to have sexual intercourse with regularity during the fertile period See *Changes in Basal Temperature* (p 2628)

PREGNANCY

Separate chapters are devoted to the physiology diagnosis and management of *pregnancy* (p 2617) and *its complications* (p 2636) Problems of the *puerperium* (p 2715) *lactation* (p 2719) and the *neonatal period* (p 2725) are also accorded concise but complete consideration

THE MENOPAUSE

The menopause marks the end of the period of reproductive function in the female It is characterized by cessation of menstruation atrophic changes in gonads and accessory sex organs and fundamental endocrine readjustments A considerable period may elapse before a new equilibrium is reached and not uncommonly the epoch is one of strain and stress marked by a group of symptoms referred to as the *menopausal syndrome* (p 2525)

The average American woman notes diminution of menses on or about the forty seventh year However the onset of the menopause has been ob

served as early as thirty five and as late as the beginning of the sixth decade It tends to occur earlier in women who have never been pregnant a late menarche often bespeaks an early menopause *Premature menopause* (p 2618) is commonly caused by ablation of the gonads roentgen castration chronic debilitating disease malnutrition or the endocrinopathies that lead to hypo ovarianism

Cessation of menses may occur suddenly but more commonly the periods space out with a slight increase in the magnitude and duration of flow Occasionally there may be a phase of polymenorrhea with irregular periods recurring at frequent short intervals finally however the flow decreases in amount and menstruation stops

Senile atrophy of clitoris and labia are among the attendant phenomena The uterus diminishes in size with involution of the muscularis and endometrium the breasts become flabby and atrophic the ovaries shrink and graafian follicles disappear smears of vaginal epithelium show many leukocytes and much debris Organ changes occur gradually and extensive atrophy is usually not present until several years have elapsed See *Kraurosis Vulvae* (p 2597)

METHODS OF DIAGNOSIS

Accurate diagnosis of disturbances of the female reproductive system requires a careful notation of the history routine examination by the practioner and laboratory aids and investigations by the obstetrician and gynecologist

HISTORY

A detailed chronologic history of the functioning of the female reproductive system is at all times a necessity Data are required relative to menstruation marriage sexual intercourse pregnancy and gynecologic surgery Although the majority of modern women are amazingly frank and straightforward in their responses to open questioning the practitioner must be on the alert for evasiveness particularly as to sexual exposure illegal abortion and the accuracy of menstrual dates Serious errors are avoided by checking on those statements that lend themselves to objective confirmation

Menstruation—The patient should be asked her age at the time of menarche the dates of the last and expected menstrual periods the normal interval between periods the duration and quantity of the flow the presence of dysmenorrhea its time and relation to the period its severity and character and the presence of intermenstrual pain or bleeding

Sexual Intercourse—Information should be obtained concerning the number of years of marriage and present marital status the age and physical status of the sexual partner the state of libido the occurrence of orgasm the presence of dyspareunia sexual and social compatability coital frequency, and the use of contraceptive measures

Pregnancy—The history of pregnancy deals with the number of gravidities and their terminations whether by induced or spontaneous abortion by stillbirth premature or full term delivery The character of each pregnancy its complications and the nature of the parturition are recounted as well as the effect of the experience upon the total economy

The Menopause —Older women are questioned concerning preclimacteric menstrual irregularities the presence of subjective symptoms such as nervousness and hot flushes and the length of time since the climacteric was established Careful attention is given to a history of vaginal bleeding or discharge occurring after the menopause (p 2527)

Special gynecologic complaints call for further leading questions

ROUTINE PHYSICAL EXAMINATION

In the conduct of the examination of child and adult virgin the practitioner is limited to visual inspection of the external genitals and digital investigation by rectum Under any and all other circumstances each female at her initial visit and periodically thereafter is subjected to a *vaginoscopy vaginal palpation* (employing abdominovaginal and rectovaginal technics) and *transillumination* and *palpation* of the *breasts* Aside from other considerations these surveys are of paramount value in the early detection of malignancy See *Changes in Basal Temperature* (p 2628)

OFFICE LABORATORY PROCEDURES

Many simple diagnostic procedures may be performed in the office laboratory Vaginal secretion is examined cytologically as an index of hormonal activity *Hang drop preparations* may reveal trichomonas (p 2598) *smears and cultures* are made for the identification of the causes of gonorrhea chancroid and granuloma inguinale the finding respectively of gram negative intracellular diplococci of *H ducreyi* or Donovan bodies leaves no doubt as to the diagnosis of each of these conditions

The detection of early infectious syphilis is made by *darkfield microscopy* (p 45) since serologic examinations at this period are usually negative Further light is shed upon the venereal infections by skin tests with *Frei antigen* (p 473) for *lymphopathia venereum* and *Ducrey antigen* for chancroid (p 289)

Blood is taken for estimation of the *sedimentation time* which is ordinarily increased in infections and for *serologic tests* for *syphilis* The investigation of *sterility* requires microscopic examination of the semen specimen which may be brought to the office or obtained from the vaginal pool

The *Schiller test* which merely involves painting the uterine cervix with a dilute iodine solution aids in the diagnosis of malignancy (p 2551)

Vaginal Smears (Routine) —Vaginal smears may indicate the functional ovarian states *Large flat epithelial cells* suggest good estrogenic activity *Small round cells* occur with inadequate function (castration menopause) The injection of estrogen corrects the cytologic picture. The smear may be used as a guide to diagnosis and therapy

Technic—The desquamated vaginal secretion is aspirated with a simple glass pipette (capillary tube with rubber bulb) The secretion is placed on a slide and stained The normal smear shows discrete cornified epithelial cells without leukocytes and debris The *menopausal* spread has a dirty smudgy appearance The epithelial cells are large and undifferentiated Bacteria leukocytes cellular debris and occasionally red blood cells are seen

Vaginal secretion may also be examined for the presence of the *Tricho*

monas vaginalis A speculum is gently passed avoiding the use of lubricant The cervix is visualized and secretion is obtained on the wooden end of an applicator This is mixed with saline solution on a glass slide and immediately examined under the high dry power of the microscope

Pregnancy Tests—During pregnancy a large amount of *gonadotropic hormone* is produced by the chorionic cells and is excreted in the urine. When such urine is injected into immature female mice (*Aschheim Zondek test*) or a virgin doe rabbit (*Friedman test*) characteristic changes occur in the ovaries which become enlarged and show corpora lutea and hemor



Fig 599—Post menstrual smear Large non-cornified cells Little evidence of estrogen effect



Fig 600—Early proliferative phase. Non-cornified cells leukocytes and mucus. Slight estrogen effect

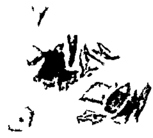


Fig 601—Pre-ovulative phase showing some cells cornified some leukocytes and non-cornified cells *



Fig 602—Ovulative phase Desquamation and aggregation of cornified cells (Height of estrogen effect)

rhage The tests are more conveniently performed by the clinical pathologist They give accurate results in 98 per cent of the trials and become positive about ten days after the first missed period In doubtful cases clinically the test if negative should be repeated in ten days to avoid false negative results The Friedman test has supplanted the Aschheim Zondek test because it is simpler and easier to read

Technic of Friedman Test—For the performance of the test the patient should be instructed to abstain from all drugs for four to five days before the freshly voided specimen is tested The first voiding of the morn

* Courtesy of Ortho Products Inc Papanicolaou stain

ing should be collected in a clean bottle without preservative The urine is brought immediately to the laboratory where it is kept in the refriger ator until injected Ten to 15 cc of the urine (*warmed to room tempera ture*) are injected into the ear vein of a mature virgin doe rabbit which has been isolated to prevent copulation The ovaries are examined twenty four to forty eight hours later for corpora lutea and hemorrhagic follicles

Interpretation—A positive Friedman test will be encountered as long as living chorionic tissue remains within the mother In addition to normal pregnancy it is positive in *ectopic pregnancy retained placenta hydatidi*



Fig 603—Post-ovulative phase Large folded cornified cells with pyknotic nuclei (*Early corpus luteum effect*)



Fig 604—Early premenstrual phase Abundance of leukocytes and mucus, in addition to folded cell (*Typical progesterone effect*)

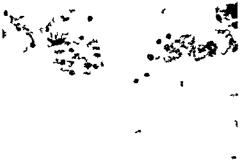


Fig 605—Late premenstrual phase Showing degeneration of epithelial cells mucus and leukocytes

form mole and *chorionepithelioma* The test is also positive in males with *teratomas* of the testis See *Changes in Basal Temperature* (p 2628)

SPECIALIST INVESTIGATIONS

The data obtained from the office laboratory are supplemented by spe cialist procedures of *uterine insufflation* and *gynecography* In the latter the cavities of the uterus and the fallopian tubes are outlined radiograph ically by opaque mixtures The early diagnosis of pregnancy is established or confirmed by *urinary tests of hormone excretion* The serviceability of

Courtesy of Ortho Products Inc.

the birth canal is often indicated by *pelvimetry* conducted externally or by radiography Histological studies are made possible by local *biopsies* and *uterine curettage* *Diagnostic laparotomy* is often a necessity in the elucidation of an obscure gynecologic condition

Tubal Insufflation—The Rubin test of tubal insufflation requires the purchase of special apparatus designed for the performance of this examination Manufacturers directions clearly depict the assembly and use of each machine

Tubal insufflation is attempted only during the five day period following cessation of menses At this time the endometrium is in a quiescent phase tests done later in the cycle may force endometrial tissue into or through the tubes thus inviting endometrioses (p 2558)

To perform the test the following technic is followed

1 Place the patient in the gynecologic position
2 Introduce the bivalve speculum cleanse the cervix and cervical canal with saline and apply tincture of merthiolate



Fig 606—Photograph of rabbit ovaries revealing a positive Friedman pregnancy test. The ovarian follicles have become greatly enlarged and hemorrhagic this occurs usually within less than twenty four hours × 2½ *

3 *Apply horizontally to the anterior lip of the cervix* a sterile short tenaculum
4 Measure the depth of the uterine cavity with a sterile sound
5 With aseptic technic adjust the rubber cuff of the uterine end of the cannula so that an air tight contact is made with external cervical os Only the tip of the cannula need be introduced to avoid any possibility of penetrating uterine wall
6 When uterine cannula is attached the stopcock is closed and the pressure within the tubing is raised with air oxygen or carbon dioxide to 80 mm of mercury
7 With stethoscope over the pubic hair line the stopcock is opened
8 If tubes are patent manometer pressure falls and the sound of the gas entering the peritoneal cavity is heard through the stethoscope

* Curtis Textbook of Gynecology

9 If there is no passage of gas the stopcock is closed the pressure is raised by 20 mm increments and observations are repeated until the pressure reaches 200 mm of mercury

10 If at 200 mm the pressure remains stationary it may be concluded that the tubes are occluded The tenaculum is released and the cannula is withdrawn

11 With patent tubes the patient notes reflex shoulder pain usually right sided within a few hours after resumption of the upright

DIFFERENTIAL DIAGNOSIS OF

Gynecologic Manifestations

The differential diagnosis of the more frequently encountered gynecologic manifestations appears in the following tables

position The discomfort may be relieved by reclining with hips raised on a pillow to prevent the intraperitoneal gas from collecting under the domes of the diaphragm

12 In the event of tubal occlusion the introduction of radiopaque solution is indicated for roentgen demonstration of the cavity of the uterus and tubes In this manner uterography and salpingography are accomplished

GYNECOLOGIC ENDOCRINOLOGY

The investigation of problems referable to gynecologic endocrinology requires particular information concerning extragenital manifestations

These include the presence of obesity (p 697) particularly of the girdle variety of emaciation skeletal overgrowth dwarfism infantilism and acromegalic or myxedematous features The development of the *secondary sex characteristics* is observed, hair distribution has some bearing upon estimates of the androgen estrogen ratio (p 2527) The thyroid gland and breasts are palpated Changes in the character and pitch of the voice are noted The eyes are examined for exophthalmos, diminution of vision and contraction of the visual fields are noted in pituitary tumors The external genitalia may be arrested in their development or overdeveloped

Laboratory examinations include estimation of the basal metabolic rate (p 3738) glucose tolerance tests (p 3716) radiographs of sella turcica and skull and examinations of the cerebrospinal fluid (p 3734)

TABLE 136—DOUCHES (FOR 2 QUARTS OF WATER)

Chemical	Amount	Remarks
Table salt	1 level teaspoonful 1½ to 2 water tumblers	Physiological saline for cleansin Hypertonic saline for trichomonas infections (p 2598)
Vinegar	⅓ glass	Ineffectual contraceptive but may be useful in trichomonas (p 2598)
Boric acid	2 teaspoonfuls	For cleansing
Potassium permanganate	Tablet of 0.3 gm (5 grain) or 1 teaspoonful of 10 per cent	Makes 1 5000 solution as antiseptic and deodorant
Tannic acid	1 teaspoonful	Astringent douche
Alum	1 teaspoonful	Astringent douche
Lactic acid	1 to 4 teaspoonfuls	In trichomonas infections (p 2598)

SPECIAL METHODS OF TREATMENT

Office gynecology is part of the daily routine of the practitioner The available forms of therapy include douching local application of ointments topical administration of drugs insufflation of powders the prescription of intravaginal suppositories the introduction of pessaries tampons and diaphragms and the systemic use of drugs and biologicals Diathermy cauterization irradiation and surgical procedures are the provinces of the specialist

DOUCHES

Vaginal douches are prescribed to lavage and cleanse the vaginal passageway to introduce a medicated solution and as a means of thermal therapy For the first two of these purposes the douche may be taken with the woman seated on the lavatory commode with the water container hung two to two and a half feet above the pelvis The douching nozzle is introduced into the vagina and the labia are compressed to distend the vagina and insure thorough cleansing For thermal therapy the douche is taken in the recumbent position usually with the patient in the bathtub

In this case the labia are alternately compressed and relaxed in order to permit water to be retained in the vagina Toxic irritating solutions should never be used germicidal solutions which upset the normal vaginal flora are avoided alkaline solutions are contraindicated lest they alter the normal range of vaginal acidity which is pH 4 0 to 5 0

OINTMENTS

Ointments are used on the external genitalia for a variety of therapeutic effects

TABLE 137—OINTMENTS FOR USE IN GYNECOLOGY

Remedy	Purpose
Calomel ointment (33 per cent)	Venereal prophylaxis
Silver nitrate (1 per cent)	Vulvovaginitis in childhood
Lassar s paste	Protective in acute infections
Nupercainal (1 or 2 per cent)	Local anesthetic
Ethyl aminobenzoate (3 to 10 per cent)	Local anesthetic
Sulfathiazole (5 per cent)	Anti infective agent
Zinc oxide (10 per cent)	Protective
Boric acid (10 per cent)	Protective
Penicillin (1 cc =1500 units)	Antibiotic

TABLE 138—TOPICAL APPLICATIONS AND INSUFFLATIONS IN GYNECOLOGY

Remedy	Purpose
Silver nitrate (1 to 0 per cent)	Cauterization
Mild silver proteinate (15 per cent)	Venereal prophylactic
Tincture of iodine (3½ per cent)	Bactericide
Sulfanilamide powder	Anti infective agent
Sulfathiazole suspension (5 per cent)	Anti infective agent
Penicillin suppository (100 000 units)	Anti infective agent
Procaine (1 to 2 per cent)	Local anesthetic
Diothane (2 per cent)	Local anesthetic
Tincture of green soap	Cleansing
Albolene petroleum jelly and tragacanth	Lubrication
Picric acid (1 per cent) suppositories	For trichomonas infections (p 98)
Devegan (paroxyl) tablets	For trichomonas infections
Acetarsone (stovarsol) powder	For trichomonas infections
Diodoquin powder	For trichomonas infections
Silver picrate (1 per cent)	For trichomonas infections
Beta lactose capsules	For trichomonas infections
Estrogen or stilbestrol suppositories	*To alter character of vaginal epithelium*

Insufflated with special powder blower

TOPICAL APPLICATIONS

Numerous substances are applied by topical application or insufflation to local areas of inflammation

VAGINAL TAMPONS

Vaginal tampons are prepared by attaching a string to a cotton or sponge They are inserted as contraceptives for the topical application of

medicaments and to absorb copious secretions The tampon is removed by pulling on the attached string A currently popular method of menstrual hygiene involves the use of a neatly prepared vaginal tampon that is conveniently inserted through a cleverly devised container

PESSARIES

See *Uterine Displacement* (p 2537)

CONTROL OF FERTILITY

The prevention of conception is necessary in the presence of certain organic and functional diseases It is frequently advisable in the newly married and for periods throughout marriage for the purpose of spacing pregnancies See *Changes in Basal Temperature* (p 2628)

The duality of the sexual function is generally recognized In addition to procreation sexual expression plays an important role in the physical and emotional wellbeing of both men and women A frequent cause of marital disharmony and frigidity on the part of the wife is the constant fear of undesired pregnancy

Planned Parenthood—Statistical studies have demonstrated the importance of spacing pregnancies to avoid too great a drain on the maternal organism and to safeguard the health of the newborn child and previously born children

The ideal interval between successive pregnancies is dependent upon a multiplicity of factors In general however a minimum interval of 18 to 24 months between successive births is recommended as one expression of the practice of modern preventive medicine

The economic and social situation of the individual family must often be the determining factor in indicating the spacing of pregnancies The number and age of living children the age of the parents the income and the help the mother can have in caring for the family are some of the many complex and diverse factors which must be taken into consideration in planning parenthood

Both male and female contraceptives are now available There is however no ideal contraceptive Most husbands object to the continuous use of condoms and many wives find other contraceptive methods unesthetic It is important to find a method which is satisfactory to both partners In many cases it will be found advisable to recommend alternative methods

The Condom—The condom is the best known and most widely used contraceptive device It is obtainable in several types of rubber and in skin made from the peritoneal covering of animal intestines The rubber condom should be tested before use by inflation for the detection of minute openings It is then rolled and applied to the erect penis by unrolling allowing a small portion at the tip for the collection of ejaculate The outer surface of the condom may be lubricated by a water soluble lubricating jelly but vaseline cold cream or other fatty substances should be avoided It is essential that the condom be worn throughout intercourse because sperm are frequently found in the mucous drop present prior to orgasm

Condoms made of skin are placed over the erect penis and then moistened with water

Sterilization of the Male—*Permanent sterilization* of the male is accom

plished by *bilateral vasectomy* (p 3938) performed under local anesthesia This operation has no effect upon the accomplishment of intercourse or the general wellbeing

The Vaginal Diaphragm with Spermicidal Jelly—The contraceptive method of choice for the female is the vaginal occlusive diaphragm used as a mechanical barrier in conjunction with spermicidal jelly or cream *Accurately fitted and carefully used the diaphragm affords almost complete protection*

The diaphragms in common use are thin circular or oval domes with protected spring rims They require individual fitting and instructions in their practical application *They are available in 55 60 65 70 75 80 85 and 90 mm sizes*

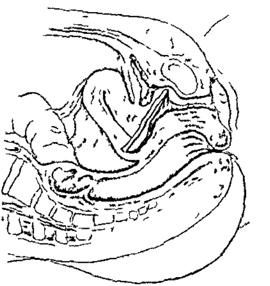


Fig 607—Sagittal cross section of normal female pelvis showing proper placement of correct-size diaphragm*

The most satisfactory method of determining the correct diaphragm is by actual introduction For this the practitioner may provide himself with a fitting set and choose the device which fulfills the following criteria

1 It must be easily introduced and worn with comfort
2 It must fit securely so that it remains in place while the patient *stands and walks*
3 When the posterior rim is placed in the posterior fornix the anterior rim should fit snugly behind the symphysis pubis

In place the diaphragm extends from the posterior fornix behind the cervix obliquely and anteriorly to the retropubic space The diaphragm *is supported anteriorly by the posterior surface of the pubis* The lateral margins of the diaphragm are held in contact with the lateral walls of the vagina by spring tension The diaphragm thus acts as a mechanical mem

* Courtesy of Ortho Products Inc

brane dividing the vagina into anterior and posterior segments The anterior segment is collapsed and contains the cervix the posterior segment provides an ample coital canal

When the diaphragm has been selected and fitted the patient is instructed in the technic of its insertion and removal She is given a prescription for the contraceptive device and for a spermicidal jelly or cream

Instructions for Insertion and Removal of Diaphragm —The entire rim of the diaphragm and the surface which is to contact the cervix are covered with a thin layer of contraceptive jelly An additional amount (approximately ¾ to 1 dram [3 to 4 cc]) is placed in the center of this



Fig 608—Position for insertion of diaphragm Left leg supported at right angle to body *

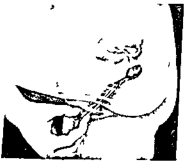


Fig 609—The diaphragm is directed along the posterior wall of the vagina to the posterior fornix *



Fig 610—The anterior rim of the diaphragm is pushed upward into retropubic space *



Fig 611—Diaphragm correctly placed, covering cervix and supported by symphysis pubis *

surface The patient is instructed to insert the diaphragm at any time within two hours before intercourse

The diaphragm is easily removed by passing index or middle finger behind the symphysis thus engaging the anterior portion of the rim which is then pulled downward and out This procedure is simplified when the diaphragm is used with the convex (or dome) surface upward The diaphragm should be left in place for six to eight hours following intercourse

If the diaphragm is not removed before six hours a douche is not necessary although a large number of patients prefer its use as a hygienic measure The douching fluid may be plain warm water using half the fluid

* Courtesy of Ortho Products Inc

prior to removal of the diaphragm and the other half following its removal. Because many women who need contraceptive instruction do not have privacy or bathroom facilities for douching, it is essential to point out that the douche is not an essential part of this method.

After removal the diaphragm is washed with soap and water, *thoroughly dried*, and dusted with talcum powder.

Spermicidal Jellies and Creams.—Jelly is generally considered the most satisfactory medium for spermicidal agents. The majority of commercially available jellies have a water soluble base. More recently, vanishing cream or soap base jellies have been made available. The spermicidal agents most frequently incorporated are lactic acid, boric acid, acetic acid, citric acid, ricinoleic acid, quinine or quinoline salts, formaldehyde, hexylresorcinol, trioxymethylene and chloramine compounds. Jellies spread rapidly at body temperature and remain effective for some time. In addition to immobilizing sperm, a satisfactory jelly or cream should form a protective covering for the external os.

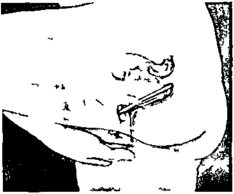


Fig. 612.—Method of removing diaphragm by hooking index finger behind anterior portion of rim.

When a mechanical barrier is refused or cannot be employed, reliance must be placed on the contraceptive jelly alone. Under these circumstances the most satisfactory method of application is through the use of the intravaginal applicator which delivers a measured dose from the supply tube. The patient is taught the location of her cervix and the method of inserting the applicator high into the vaginal vault. Use of the applicator obviates the dangers inherent in the delivery of too small or too great a quantity. The applicator should be thoroughly washed after each use in order to avoid sticking of the plunger. A douche the following morning may be advised as a hygienic measure but is not essential.

Due to the greater esthetic acceptability of creams, several preparations of this type have been developed. They are not hygroscopic and mix well with vaginal and seminal secretions.

Council accepted contraceptives include Ramses and Ortho diaphragms, each with inserters, and Ortho creme or Ortho gynol vaginal jelly with vaginal applicators.

Courtesy of Ortho Products, Inc.

Cervical Caps—If the patient cannot be fitted with a vaginal diaphragm a cervical cap may be prescribed This device fits over the cervix is held in place by suction and does not depend on the integrity of the vaginal musculature

Cervical caps are available in small medium and large sizes They are introduced digitally but are only successful if the cervix projects sufficiently within the vagina to be within reach and if laceration or deformity does not destroy the suction necessary for holding the device in place

Cervical and Intra uterine Stems—No type of cervical or intra uterine stem should ever be recommended as a contraceptive method Cervical stems made of hard rubber or metal with a broad base designed to cover the external os are infrequently used as contraceptive devices They require introduction by the physician in the post menstrual phase and are removed by him prior to the next menses

The gold button or wishbone intra uterine stems are potentially dangerous They are designed to permit the passage of menstrual blood and are left in place for periods of several months or years Two general forms are chiefly available and they are mentioned only to be condemned

A rigid stem such as the wishbone type is made of gold or other metal and consists of a button like base on which are mounted two bent prongs the lower portions of which are covered by a spiral spring The spreading prongs hold the device within the uterus where it is allowed to remain for a period of months or years

A flexible stem consists of a base on which is mounted a tapering spiral spring The spring has its widest diameter at its distal third and it is this portion which holds the device in place within the uterus While the chances of perforation of the uterus are minimized with this device the use of any form of stem is inadvisable since ascending infection may be introduced into the uterine cavity and a foreign body reaction may be initiated in the cervical canal and uterine cavity producing irritation infection carcinogenic action or perforation of the uterus

Intra uterine Rings.—In order to obviate the irritant effect of a foreign body within the cervical canal Ernst Grafenberg devised the ring which bears his name and which consists of a circular spiral silver spring These flexible rings are available in various sizes and are introduced within the uterine cavity by means of a notched sound Other intra uterine rings have been made of twisted catgut and other materials These rings are left in place for a period of several months or years They are then removed by the hooked end of the sound Reports of this method lighting up a quiescent salpingitis or causing marked uterine contractions and excessive bleeding are frequent and about one in eight rings is extruded without the patient s knowledge In addition numerous cases of pregnancy with the ring *in utero* have been reported The consensus of American gynecologists is that this method is unsound and potentially dangerous It should never be recommended

Douching—Douching directly following intercourse is a commonly advised and frequently practised method of contraception Its relative ineffectiveness is explained by the fact that a large number of spermatozoa may be deposited in the cervical mucous plug or the cervical canal at the time of ejaculation Even if a spermicidal douche is used immediately

after intercourse spermatozoa which have entered the cervical canal or mucous plug will be unaffected

The various chemicals ordinarily used in douching fluids such as phenol and mercurial derivatives are irritating to the vaginal mucous membrane Other preparations are absorbed through the mucous membrane and may have systemic effect especially due to the false belief that two or three times the amount prescribed will be more effective Cases of severe vaginitis and systemic toxemia have been reported as a result of the use of toxic substances in douching solutions

The douche is not reliable or advisable as a contraceptive means but it may be used as a hygienic measure For this purpose it is unnecessary for the douching fluid to contain a spermicidal agent and the physician may prescribe plain warm water Under no circumstances should any ingredient be prescribed which would be irritating to the vaginal mucous membrane or which is absorbable Bichloride of mercury is particularly avoided

If the douche is to cleanse the vagina adequately the vaginal walls must be distended This may be accomplished by the use of a bulb type of syringe equipped with an adjustable collar or cone which prevents the free outflow of water The patient is instructed to exert gentle pressure on the bulb with thumb and index finger in order to avoid excessive intravaginal pressure When the fountain type syringe is used the bag or container is placed no higher than two feet above the pelvic plane the labia are held together manually to obstruct return flow and moderately distend the vagina Patients must be warned of the possibility of forcing potentially infected fluid into the uterine cavity through the incorrect use of either method of douching they should be cautioned of the danger inherent in the use of commercially exploited dilating sprays and mechanical vaginal dilators

Suppositories and Effervescent Tablets—Contraceptive *suppositories* are made with cocoa butter and contain small amounts of quinine or other spermicidal agents (p 2505) The suppository is simple compact easily concealed and free from nuisance but it cannot be relied upon consistently to fulfill its purpose The same advantages and disadvantages are inherent in the *effervescent tablets* which are popularly used

The Council on Pharmacy however has given its approval to a suppository marketed as Pernox whose main ingredients are ricinoleic acid and propylene glycol monostearate

Lactation—Popular opinion to the contrary lactation offers minimum if any protection against impregnation

There is a wide variation in the re establishment of menstruation during the period of lactation One study indicated that during the first three months of lactation 25 per cent of the women under observation menstruated while for the whole nursing period 50 per cent menstruated These figures may serve to indicate the possibility of impregnation during lactation Furthermore ovulation may take place independent of menstruation and the menses may not always be trusted as the only indication of susceptibility to pregnancy In this connection pregnancy has been reported in adolescent girls who had never previously menstruated Furthermore the accepted relationship between ovulation and menstruation

would make it possible for conception to take place prior to the first post partum menstrual period

With the growing acceptance of the desirability of child spacing avoid ance of conception during the lactation period becomes of increasing im portance and the prescription of a dependable contraceptive method at this time is advisable

Safe Period—See p 2490 and p 2628

Irradiation—Temporary or permanent arrest of ovulation may be ac omplished in animals and human beings by sufficient exposure to x ray or radium irradiation Irradiation however *is not selective* and affects other endocrine activities of the gonads so that it should never be recom mended as a means of temporary sterilization Only in rare and selected cases is permanent sterilization by this method warranted

Surgical Sterilization—In contrast to contraception which has as its main purpose the temporary prevention of pregnancy sterilization is in tended to bring about permanent infertility The operation for sterilization should be performed only when the indications are incontrovertible and when no possibility exists that these indications are remediable The proce dures include *salpingectomy salpingotomy* or *tubal ligation* by abdominal or vaginal incision In addition to surgical procedures *electrocoagulation of the tubo uterine junction* has been performed and there is sufficient evi dence to warrant its recommendation in selected cases where sterilization is desirable and no other intra abdominal surgery is indicated

Combined Methods—With the dissent of both associate editors the senior editor favors a combination of contraceptive devices for couples whose marital relationships are mutually well established He recommends omission of contraceptive devices or at most the use of the spermicidal jelly or cream for the last ten days preceding the onset of the next ex pected menstrual period and for the first two days following the termina tion of each period provided that the cycle is comparatively regular at approximately 28 or 30 day intervals

For the remainder of the menstrual month, which includes the period of fertility condom and vaginal diaphragm are alternated so that at most each partner is required to control fertility only a few times monthly

ARTIFICIAL INSEMINATION

In artificial insemination (test tube baby) the husband s semen is used if the specimen is satisfactory Under other circumstances a donor must be found and the procedure is carried out after all necessary medico-legal steps have been taken

Utilization of the husband s semen is attempted if the volume of the ejaculate is small but the sperm are normal in morphology with only a small percentage of abnormal forms (p 2400) The specimen is diluted with nutrisal to bring to normal its volume

Repeated attempts should be made with the husband s semen if the infertility seems to rest upon an organic basis relative to the female geni talia (the cervical os is so placed that it is impossible for the seminal pool to bathe the cervix as in retroversion, there is a thick tenacious cer vical plug or a highly acid reaction in the upper vagina)

If the semen is wholly unsatisfactory or efforts at artificial insemination

of the husband s ejaculate have proved unsuccessful a healthy donor is chosen Tests are made for syphilis gonorrhea and Rh factors The physician should take pains to see that the donor has no knowledge of the identity of the parents and that the parents have no knowledge of the identity of their donor However legal assistance should be summoned to draw a suitable agreement signed by all parties concerned so that the physician is protected against later repercussions

Artificial insemination is carried out during the period of fertility (p 2491) The semen specimen is obtained within a few hours of the proposed insemination It is drawn up into a syringe to which is attached a long cannula similar to that which is used for trans uterine insufflation The patient is placed in the gynecologic position and a bivalved speculum is introduced The cervical plug is removed by aspiration or lavage if necessary The tip of the cannula is then inserted into the cervical canal and 0 5 cc of semen is introduced The remaining portion of the semen is then discharged into a previously fitted vaginal occlusive diaphragm Particular care is exercised to avoid the use of any lubricating jelly since many of these products impede sperm motility The vaginal diaphragm is then inserted so that the cervical os is bathed with semen for a period of several hours Following insemination the patient remains on the examining table for 20 minutes and she is instructed to leave the diaphragm in place until the following day

PHARMACOTHERAPY

Many useful as well as useless remedies are employed for their systemic effects on the female reproductive system The prevalence of menstrual disorders has attracted the attention of patent medicine concerns who exploit feminine credulity by the sale of inert preparations dispensed in alcoholic vehicles which closely approximate gin in taste and effect There is no known proprietary whose benefits cannot be more safely and inexpensively obtained by one or other of the official drugs

The principal pharmacotherapeutic actions are oxytocic ecbolic abortifacient sedative hemostatic aphrodisiac anaphrodisiac antibacterial spermicidal and endocrinologic

OXYTOCICS AND ECBOLICS

Oxytocic drugs stimulate uterine muscle by a direct action The term ecbolic is employed when the oxytocic is used to effect evacuation of the uterine cavity Their effect on the uterus is selective and whereas smooth muscles of other organs respond to their administration the effect is comparatively negligible The most important oxytocics and ecbolics are ergot posterior pituitary preparations physostigmine quinine and castor oil

Ergot and Its Derivatives—Ergot is a fungus that is parasitic on the rye plants It contains numerous alkaloids of which *ergotamine* and *ergonovine* are effective therapeutic agencies Fluid extracts of ergot and unstable preparation of the crude drug have been replaced by the more reliable pure alkaloids

Bioassay of Ergot—Crude ergot preparations are standardized by a bioassay method which depends on the production of gangrene in the *cock s comb* The potency is measured against crystallized Ergotoxine ethane sulfonate purified alkaloids do not require bioassay

Pharmacology—The ergot preparations *potentiate uterine muscle activity* Small doses result in contractions of normal quality larger ones produce temporary tetany The sensitivity of the uterus to ergot varies with its physiological state the non pregnant uterus is least susceptible while the gravid uterus at term is extremely reactive

The ergots *raise blood pressure* by a direct action on the smooth muscle of arterioles Significant elevation of blood pressure is accompanied by a reflex *bradycardia* The ergot drugs have the capacity for producing lesions of capillary endothelium and this unfortunate action may result in *thrombotic vascular occlusion* and *gangrene*

Therapeutics—The therapeutic activities of ergotamine and ergonovine reveal qualitative and quantitative differences *Ergotamine* is poorly absorbed from the gastro intestinal tract and its action once initiated is prolonged the effect is noted 20 minutes after intramuscular injection and may be sustained for 2 or 3 hours

Ergonovine is readily absorbed from the gastro-intestinal tract and acts within a few minutes after oral administration intravenous injection results in an immediate uterine response Ergonovine is at present the

TABLE 139—ERGOT PREPARATIONS

Preparation	Dose	Remarks
Fluid Extract of Ergot USP	2 cc	Unstable preparation
Aseptic Ergot NNR	*1 cc*	*Ampoules for intramuscular use*
Ergotamine Tartrate (Gynergen NNR)	0 25 and 0 5 mg	Ampoules for intramuscular use
	1 cc = 1 mg	Ampoules for intramuscular use
	1 mg (1/60 gr)	Tablets for oral use
Ergotrate (Ergonovine)	0 2 mg (1/320 gr)	Tablets of ergonovine for oral use
Ergotrate II (Ergonovine)	0 2 mg (1/320 gr)	Ampoules for intramuscular or intravenous use preferred preparation

preparation of choice The drug rarely manifests *side actions* blood pressure effects are slight and the uterine effects are maximum

The oxytocic effects of ergot are primarily *utilized for the control of post partum bleeding* The use of these preparations to *induce labor* or *stimulate contractions* during the course of childbirth is fraught with danger and greatly to be deprecated For post partum bleeding ergonovine *in a dose of 0 2 to 0 3 mg* gives a rapid and durable response producing contraction of uterine muscle and effective hemostasis by clamping off uterine sinuses *The drug is generally given intramuscularly* or by vein The effect of ergotamine tartrate is similar but slower and more sustained *As gynergen its greatest effectiveness is demonstrable in the treatment of* migraine (p 1508)

Toxicity—*Acute ergotism* causes dramatic symptoms that are most often the result of idiosyncrasy rather than overdosage The prolonged effects of ergotamine in this regard make it a less desirable clinical preparation than ergonovine With acute poisoning the pulse becomes thready there develop marked thirst paresthesias of the skin gastro intestinal distress confusion and coma the extremities become cold eless

With *chronic ergot poisoning* there is a slower development of the same symptoms and eventual gangrene of fingers and toes

Antidotal treatment consists in cessation of the drug and the use of vasodilators such as papaverine (p 3854) mecholyl (p 3874) or the nitrites (p 3892) Gangrene may be averted by intermittent venous occlusion (p 851)

Posterior Pituitary Extracts—Posterior pituitary extracts elsewhere described in greater detail possess an oxytocic factor which may be obtained relatively free from the pressor diuretic and antidiuretic principles Pitocin N N.R is available in 1 cc ampoules for intramuscular injection and may be used as ergonovine to produce involution of the uterus and control post partum bleeding Its irregularity of action and tendency to produce intestinal cramping make it less desirable than ergonovine which is pre ferred by most obstetricians

Neostigmine—Neostigmine (prostigmine) is one of several cholinergic drugs elsewhere described in greater detail As an oxytocic and ecbolic it is inferior to ergonovine and pitocin It has a greater tendency to produce intestinal stimulation a fact which may be utilized therapeutically if sub involution of the uterus is combined with paralytic ileus

Neostigmine is obtained in ampoules of 1 and 2 cc containing 1 2000 or 1 4000 dilutions It is chiefly employed by obstetricians in the management of delayed menstruation Injections are given daily for 3 days if the period does not make its appearance it may be concluded that the patient is probably pregnant and urine tests are indicated for confirmation or denial

Quinine—The salts of quinine are widely used by obstetricians for the *induction of labor* though the pharmacological evidence for activity is questionable to say the best Presumably quinine acts directly on uterine muscle increasing weak contractions in early labor The antimalarial (p 517) actions of quinine salts are elsewhere discussed

By custom *Quinine Sulfate* is given orally in dosages of 0 2 to 0.3 gm (3 to 5 grains) at hourly intervals until labor begins Usually the alkaloid is *given simultaneously with a dose of castor oil which is also* alleged to initiate uterine contractions at term

Castor Oil—With all due reservation and apology it is our opinion and experience that the heroic use of *castor oil* (p 1829) for the induction of labor adds to the discomfort and dehydration of the mother and produces at best minimum and inconsequential uterine effect

ABORTIFACIENTS

The long list of reputed abortifacients testifies to the fact that no one has any significant effect The roster includes the oxytocics (p 2509) vola tile oils (Pennyroyal apiol turpentine savin) and estrogens Most preparations given in sufficient dosage add to the discomfort of the pregnant woman and may cause serious poisoning

The lay reputation of the abortifiacients is due to arguments post ergo propter If a period occurs after the use of a drug it is most likely that the woman was never pregnant or if pregnant that she spontaneously miscarried In either event menstrual bleeding would have occurred with out benefit of medication

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The phenomenal results obtained by the antibiotic substances leaves little necessity for consideration of preparations previously used Despite the advance made by intensive arsenotherapy in the treatment of preg nancy and neonatal syphilis (p 2787) penicillin gives promise of equally favorable results with lesser risk Either penicillin or sulfonamide may be used to replace silver in the treatment of gonorrhea and streptococcus antiserums in puerperal fever In all likelihood arsenic bismuth mercury silver the dyes and serums will occupy at best an accessory role in those few infections in which penicillin and/or sulfonamides are unsuccessfully employed

THE STEROID HORMONES

The *ovarian testicular* and *adrenal cortical* hormones belong to a group of compounds known as steroids a name applied to substances contain *ing the cyclopentenophenanthrene carbon skeleton Structural similarity* is the basis for important physical and chemical properties common to these hormones and for the interesting tendency for their pharmacological ac tions to overlap The pure hormones are crystalline soluble in oil and other organic solvents (alcohol ether propylene glycol) and sparingly soluble in water In every instance the pure hormone or some relative of it pos sessing a similar action has been synthesized The steroid hormones or their derivatives are effective after absorption from the gastro intestinal tract but they are most effective when administered parenterally as an oily solution of the hormone or as pellets of the crystalline hormone In most instances (progesterone being the exception) the activity of the steroid hormones is prolonged by the formation of fatty acid esters (ben zoic acid acetic acid propionic acid esters)

Untoward reactions to the steroid hormones are uncommon in contrast to the relative frequency of such reactions in patients receiving the protein hormones (insulin anterior pituitary) In addition tachyphylaxis or a diminishing response to repeated injections is rare in comparison to the protein hormones whose use may lead to antihormone or antibody responses

The *steroid hormones being pure drugs should be administered with* the same regard for dosage and toxicity as other powerful pure drugs whose action is better known They are dispensed according to weight

Estrogenic Activity and its Sources—Estrogenic activity may be defined as the ability to stimulate the growth of the accessory sex organs of the female castrate Compounds with this physiological property are produced not only by the ovarian follicles but also by the human placenta the adrenal cortex adrenal cortical tumors and the testes They have been *isolated from such diverse sources as yeast germinating seeds pussy wil* lows palm oils and ergosterol The estrogenic property is not dependent on the presence of the phenanthrene (steroid) nucleus Estrogenic phenyl ethylene compounds have been *synthesized (diethylstilbestrol triphen ylethylene)*

The graafian follicles of the ovary produce a hormone (*folliculin*) which *is necessary for the development and maintenance of the accessory sex* organs and the secondary sexual characteristics of the female In the mature female it produces a cyclic proliferation of the mucosa of the uterus and vagina (*menstruation*) and of the ducts of the mammary glands In addi

The phenomenal results obtained by the antibiotic substances leaves little necessity for consideration of preparations previously used. Despite the advance made by intensive arsenotherapy in the treatment of pregnancy and neonatal syphilis (p 2787), penicillin gives promise of equally favorable results with lesser risk. Either penicillin or sulfonamide may be used to replace silver in the treatment of gonorrhea, and streptococcus antiserums in puerperal fever. In all likelihood arsenic, bismuth, mercury, silver, the dyes and serums will occupy at best an accessory role in those few infections in which penicillin and/or sulfonamides are unsuccessfully employed.

THE STEROID HORMONES

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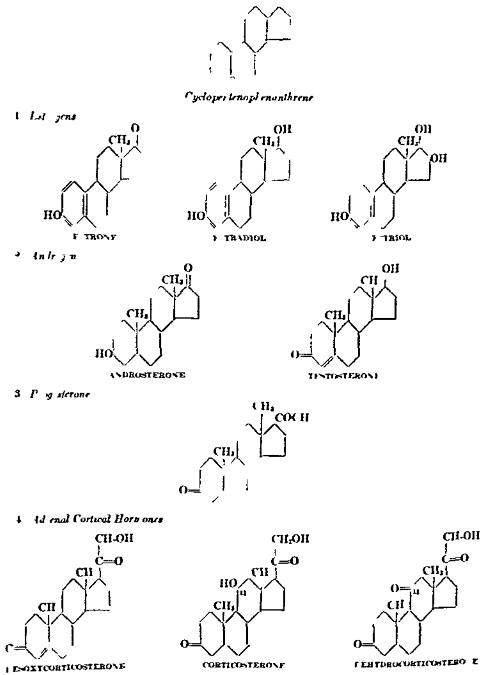
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The graafian follicles of the ovary produce a hormone (*folliculin*) which is necessary for the development and maintenance of the accessory sex organs and the secondary sexual characteristics of the female. In the mature female it produces a cyclic proliferation of the mucosa of the uterus and vagina (*menstruation*) and of the ducts of the mammary glands. In addi-

tion the muscular walls and supporting stroma of the organs are stimulated and the spontaneous activity of the uterine muscle is increased



Structural formulas and chemical relationships of steroid hormones

Large doses of follicular hormone depress the formation of the gonadotropic hormone of the anterior pituitary gland and thus indirectly suppress normal gonadal activity Excessive amounts of the hormone in labora-

tory animals produce increased calcification of the long bones carcinomas of the breast and uterus and abortion

The Estrogens—A variety of natural and synthetic estrogens are available *for clinical use* Present practices favor the synthetics for accuracy dependability and oral effectiveness

Units and Bioassay—The *crystalline estrogenic substances* being pure drugs are given by weight the dose is determined empirically in the individual patient The activity of *concentrates* prepared from pregnancy urine blood and tissues must be determined biologically and is expressed as units

TABLE 110—ESTROGEN PREPARATIONS

Product	Remarks
Estradiol (Dihydroxyestrin)	The naturally occurring follicular hormone May be obtained from ovaries and pregnancy urine of humans and mares
Estradiol Benzoate U.S.P	Fatty acid ester of estradiol
Estradiol (D propionate)	Fatty acid ester of estradiol
Estrone (Ketohydroxyestrin) U.S.P	Official standard of estrogenic activity ⅛ strength of estradiol derived from similar sources
Estriol (Trihydroxyestrin)	Hydrated form of estrone in pregnancy urine 1/10 strength of estrone but more effective orally
Emmenin	Glycuronate of estriol derived from placenta for oral use
Stilbestrol (Diethylstilbestrol)	Synthetic product for oral and parenteral use dose 0.5 to 10 mg
Ethinyl Estradiol	Synthetic product less effective than stilbestrol
Hexestrol	Tablets 0.2 1.0 and 3.0 mg Ampoules 1 mg per cc
Octofollin	Synthetic unrelated to stilbestrol dose 5 to 15 mg less potent than stilbestrol but fewer untoward side effects

The physiological criterion of activity is the appearance of the cells in the vaginal smear of a castrated female rat or mouse (Allen Doisy test) The threshold dose of a given estrogen for producing estrus as determined by the Allen Doisy technic is called *one rat unit* or *one mouse unit* A unit of this type does not consider the duration of estrus Many experimental factors modify the comparison of potency of different compounds assayed by this method

The *international unit* is defined as the specific estrus producing activity contained in 0.1 μg (0.0001 mg) of standard crystalline estrone The introduction of compounds less effective in inducing estrus per unit of weight but having a more prolonged effect than estrone led to the adoption of the *international benzoate unit* This represents the estrogenic activity of 0.1 μg of crystalline estradiol benzoate The international units are

arbitrary biometric units and bear no true relationship to biological activity determined by the Allen Doisy test

Administration—Estrogenic effects can be obtained orally intravaginally by suppository, parenterally by subcutaneous or intramuscular injection by inunction and by implants of pellets

The introduction of synthetics such as stilbestrol, hexestrol and octofollin greatly simplifies practical therapy since these may be given orally with highly satisfactory results and minimum toxicity With resistant symptoms recourse may be had to injection therapy or to substitution of any one of the natural estrogens Vaginal suppositories may be retained for use in infantile vulvovaginitis of gonorrheal origin senile vaginitis and kraurosis vulvae

Therapeutics—Estrogen therapy is employed in the treatment of both females and males

In the female, estrogens are indicated in hypogonadism (p 2523) the menopause (p 2525) for suppression of lactation (p 2719) in senile vaginitis (p 2600) kraurosis vulvae (p 2597) and gonorrheal vulvovaginitis in infancy (p 2586) The principal use of estrogen in the male rests in the control of metastatic prostatic carcinomatosis (p 2449) Details of therapy are given as indicated in the several sections

In addition to disorders of the genital structures estrogen may be used *in extra gonadal conditions such as atrophic rhinitis diabetes* mellitus diabetes insipidus and senile osteoporosis

ATROPHIC RHINITIS—The relation of the nasal mucous membrane to the cyclic uterine changes has long been recognized by clinicians who not uncommonly encounter epistaxis during menstruation (*vicarious menstruation*) Growth of the nasal mucosa has been observed after estrogen administration which suggested its application to the treatment of atrophic rhinitis

Estrogen in olive oil supplied by a nasal atomizer in doses of 1000 to 10 000 international units two to three times daily may prove of benefit After one or two weeks the applications are gradually reduced in number and frequency and by the eighth week one application weekly may be sufficient The beneficial results have been attributed to the hyperemia of the nasal mucosa Males as well as females have been helped with this treatment *Sinusitis may be aggravated by the estrogens and* is *a* contraindication to their administration

Papilloma of the larynx and *leukoplakia buccalis* have also been reported to respond favorably to estrogen therapy

DIABETES MELLITUS—The ability of the estrogen to depress the formation of gonadotropic hormone in menopausal females has led to the use of estrogens where it was desired to produce a general depression of anterior pituitary activity In cases of diabetes mellitus requiring large doses of insulin (1000 to 2000 units daily) estradiol has been administered to counteract the possible overproduction of an insulin antagonistic substance by the anterior lobe Large doses have been shown capable of diminishing the hyperglycemia in cases refractory to usual doses of insulin and in a few cases have diminished insulin insensitivity In view of the spontaneous fluctuations in the insulin requirement of diabetics the value of estrogen therapy is difficult to establish

The role of the anterior lobe in diabetes mellitus remains to be clearly established However it is interesting and perhaps significant that there is a sharp rise in the incidence of diabetes mellitus after the menopause

DIABETES INSIPIDUS —The anterior pituitary is responsible for the maintenance of the polydipsia and polyuria of diabetes insipidus Removal of the anterior lobe in experimental diabetes insipidus or its destruction by disease in human cases abolishes the syndrome There have been several attempts to depress the function of the anterior lobe in patients with diabetes insipidus by the injection of large doses of estrogen

In several reports impressive diminution in polydipsia and polyuria have been recorded during estrogen therapy However in other cases no definite benefit was observed In view of the rarity of diabetes insipidus detailed studies of additional patients are needed before estrogen therapy in this condition can be evaluated

SENILE OSTEOPOROSIS —Large doses of estrogen produce increased calcification of the bones in laboratory animals In a study of the skeletal changes seen after the menopause Albright found a high incidence of osteoporosis which he attributed to a failure of the bone forming process The use of estrogens was associated with an arrest of the conditions and the relief of symptoms (bone and joint pain) Similar improvement has been noted in the condition known as menopausal arthritis

Toxicity —Whereas the natural estrogens are singularly free from untoward side effects the synthetics more so with stilbestrol than octofollin may produce nausea vomiting abdominal distress anorexia diarrhea lassitude dermatoses and thirst The appearance of any of these annoyances requires substitution of another product a natural estrogen by intramuscular injection

Much more alarming than the minor disturbances of the estrogens is their *carcinogenic effect* more easily demonstrable in the laboratory than the clinic The senior author has been so impressed by the ominous potentialities that he has consistently refused to give estrogen therapy unless the indications are sufficiently important and incapacitating to warrant what he considers the hazard He prefers to rely on gonadotropin where indicated or simple sedation as in menopausal disorders

PROGESTERONE

Preparations Sources and Chemical Properties —Progesterone is a crystalline steroid related chemically to the natural estrogens and androgens and the adrenal cortical hormones Small quantities of progesterone have been isolated from the *adrenal cortex* *Ovarian extracts* yield quantities too small for therapeutic use

The chief commercial source for progesterone is the synthesis from *stigmasterol* (a sterol found in soy beans) or from *cholesterol* The hormone has been prepared from *pregnandiol* a steroid found in human pregnancy urine Pregnandiol is regarded as a metabolic end product of progesterone

Progesterone is soluble in vegetable oil (olive sesame peanut) and insoluble *in* water It is ineffective after oral administration either from the failure of absorption or its destruction in the gastro intestinal tract

After the intramuscular injection of the oily solution, absorption is slow and the effects of a single large injection may last a week

The hormone is excreted in the urine as *pregnandiol* which retains the salt and water retention properties of progesterone The estimation of the amount of pregnandiol excreted in the urine serves as an index of the production of progesterone

Pregneninolone (anhydro hydroxy progesterone, ethinyl testosterone) is a synthetic steroid having progestational properties when given by mouth It is less active intramuscularly than is progesterone but is more active than progesterone by mouth The compound is mildly estrogenic and mildly androgenic It may produce nausea

The term *progestin* is used to designate the whole group of substances having an action similar to progesterone and to describe such a factor in an impure state

Unitage and Bioassay—Progesterone being a pure principle is administered by weight The amounts used are determined by clinical trial using laboratory studies as a guide to physiological efficacy and toxicological effects Impure compounds have their progestational activity determined by their ability to convert the uterine mucosa of a test animal from a proliferative to a secretory phase The *international unit* is defined as the amount of progestational activity present in one milligram of crystalline progesterone

Physiology—The progestational hormone promotes the growth of the uterine endometrium in preparation for the implantation (nidation) and nourishment of the embryo In the nongravid female and during the first three months of pregnancy progesterone is formed by the corpus luteum From the end of the first trimester until term it is furnished chiefly by the placenta The hormone is essential to the maintenance of early pregnancy Death of the corpus luteum before the end of the third month results in abortion

Progesterone suppresses ovulation during pregnancy and inhibits the spontaneous activity of the uterine myometrium until just before parturition It stimulates the growth of the secretory portion of the mammary glands It has definite effects on water and electrolyte metabolism inducing a retention of sodium chloride and water in the body

Therapeutics—The chief therapeutic uses of progesterone are based upon its sedative influence on the muscular movements of the uterus and upon its role in the maintenance of early pregnancy

The human uterus is not a quiescent organ but its muscular walls give rise to rhythmic waves of contraction arising in the fallopian tubes and passing through the body of the uterus to the cervix Activity is most marked in the tubes and in the fundus of the uterus and least in the region of the cervix After ovulation uterine activity is reduced in preparation for nidation The uterus becomes firm and quiescent until two days before the onset of menstruation when the corpus luteum regresses and motility is resumed as a result of estrogen stimulation During pregnancy the uterus remains quiescent until term when the influence of the progestational hormone wanes

Threatened Abortion—Between the seventieth and ninetieth days of pregnancy the function of the corpus luteum is assumed by the placenta

During this transition phase a deficiency of progesterone may occur and favors an increase in uterine activity leading to dislodging of the embryo and abortion Theoretically threatened abortion is a chief indication for progesterone since it can do no harm and may be beneficial

As soon as a threatened abortion is suspected in addition to the established methods of treatment progesterone should be given in doses of 5 to 10 *mg daily by intramuscular injection until symptoms subside After* one or two weeks of daily injections they may be continued at less frequent intervals (once to twice weekly) until the patient is well into the fourth month of pregnancy

Habitual Abortion—The repeated expulsion of the embryo early in pregnancy in many instances results from the failure of the decidua to provide a proper environment for embryonic growth as well as from undue activity of the uterine musculature Local endometrial deficiency may be the organic basis for repeated abortion in poorly controlled diabetics or in patients with hypothyroidism (p 2469)

Certain cases of habitual abortion are due to progesterone deficiency A trial of progesterone therapy may result in a successful pregnancy As soon as pregnancy is suspected in a patient who has had a series of spontaneous abortions progesterone should be administered in doses of 5 to 10 mg daily This represents the amount of progesterone formed daily by the normal pregnant female as determined by pregnandiol excretion studies Injections should be continued until the fourth month of gestation when the placental source of progesterone becomes adequate Patients receiving daily injections of progesterone should limit their dietary intake of sodium chloride in order to avoid excessive retention of water and sodium chloride

Dysmenorrhea—The ability of progesterone to relax the uterine contractions is the basis for its use in the treatment of dysmenorrhea About one half the cases of dysmenorrhea are said to benefit from its use The treatment is merely symptomatic not curative and must be repeated with each subsequent period The usual method is to give intramuscular injections of 1 or 2 mg daily for three to four days before the onset of the expected period Occasionally such treatment may delay the onset of menstruation (p 2561)

After Pains—Following parturition painful uterine contractions may be relieved by the intramuscular injection of 1 mg of progesterone

Functional Bleeding—Progesterone deficiency and hyperestrenism are believed to be the basis of some instances of menorrhagia and metrorrhagia encountered in young women In such circumstances progesterone may prove of value since this hormone reduces or interferes with the effect of estrogens Progesterone should be given intramuscularly in doses of from 2 to 10 mg (1/30 to 1/6 grain) daily for five to ten days Ordinarily the bleeding ceases after the second or third dose and may recur forty eight to seventy two hours after injections are stopped Occasionally bleeding does not stop and may even increase during progesterone therapy In some cases that respond to this treatment normal periods may be resumed

ANTERIOR PITUITARY HORMONES

The anterior pituitary hormones are described in greater detail in the chapters dealing with the Endocrine System (p 1154) Relative to the

After the intramuscular injection of the oily solution absorption is slow and the effects of a single large injection may last a week

The hormone is excreted in the urine as *pregnandiol* which retains the salt and water retention properties of progesterone The estimation of the amount of pregnandiol excreted in the urine serves as an index of the production of progesterone

Pregneninolone (anhydro hydroxy progesterone ethinyl testosterone) is a synthetic steroid having progestational properties when given by mouth It is less active intramuscularly than is progesterone but is more active than progesterone by mouth The compound is mildly estrogenic and mildly androgenic It may produce nausea

The term *progestin* is used to designate the whole group of substances having an action similar to progesterone and to describe such a factor in an impure state

Unitage and Bioassay —Progesterone, being a pure principle is administered by weight The amounts used are determined by clinical trial using laboratory studies as a guide to physiological efficacy and toxicological effects Impure compounds have their progestational activity determined by their ability to convert the uterine mucosa of a test animal from a proliferative to a secretory phase The *international unit* is defined as the amount of progestational activity present in one milligram of crystalline progesterone

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Threatened Abortion —Between the seventieth and ninetieth days of pregnancy the function of the corpus luteum is assumed by the placenta

PELVIC DIATHERMY

See p 3788

CAUTERIZATION OF CERVIX

See p 2601

RADIOTHERAPY

Roentgen and radium therapy are valuable assets in the treatment of functional and neoplastic disturbances of the female reproductive system Roentgen therapy is utilized in the production of artificial menopause the control of uterine bleeding intractable dysmenorrhea endometriosis and uterine fibroids It is also used when generalized irradiation is needed for inaccessible and inoperable malignancy *or following the removal of a* cancer

Radium therapy is the province of the expert *Radium is most com*monly used as radium sulfate which is marketed in glass tubes *preserved* in capsules of platinum or gold It is also introduced as radium *emanation* or *radon* which is buried in minute glass *seeds* These may be left permanently within the patient although there is reason to believe that the residual seeds may produce disturbing changes

Radium has its most important usefulness in gynecology in the treatment of *uterine bleeding* (p 2565) at the menopause and in the treatment of *cancer of the cervix* (p 2551) The element is placed in the cavity following diagnostic curettage Technical details necessitate care by the expert Radium is not inserted into the uterus until a diagnostic curettage elucidates the nature of the bleeding process Treatment is contraindicated if there is active or quiescent pelvic infection or submucous or pedunculated tumors that may undergo necrosis and sloughing

OBSTETRIC AND GYNECOLOGIC SURGERY

Obstetric and gynecologic surgery constitutes 80 to 90 per cent of operative work done in ordinary clinical practice In large part the procedures are those of election (p 3996) the technics are not difficult the risks are slight preoperative and postoperative care pose few problems and the results are excellent

OPERATIVE OBSTETRICS

In the operative field many obstetricians do routine *episiotomy* (p 2693) to preserve the perineum avoid extensive laceration and shorten labor The skilful use of *forceps* (p 2694) is an invaluable adjunct to good obstetrical practice The more serious obstetrical procedures include *cesarean section* operations indicated in ectopic pregnancies and panhysterectomy

Cesarean section is certainly the most dramatic of all surgical procedures The removal of the child through an abdominal incision and hysterotomy requires speed courage and fine cooperation from the operating team When indicated it is a procedure that may save alike the life of mother and child *When performed unnecessarily* through selfishness on the part of mother or obstetrician it is a culpable procedure

The operation indicated in *ectopic pregnancy* depends upon the opera

female reproductive organs these complicated and vitally important products function as gonadotropins and lactogens

Anterior pituitary lactogenic hormone is demonstrably beneficial in stimulation of milk secretion after childbirth as elsewhere described (p 2719)

Anterior pituitary gonadotropin normally stimulates the secretions of estrogen and progesterone It may be employed in any situation in which these hormonal activities are secondarily depressed as a result of pituitary sluggishness Paradoxically if employed while the ovaries and corpus luteum are functionally normal the latter may be strikingly depressed

Chorionic gonadotropin in lyovac ampoules is included in New and Non official Remedies by the Council on Pharmacy

ANDROGEN

The androgens have a number of interesting actions in the human female They suppress the formation of the anterior pituitary gonadotropic factor which leads to a depression of ovarian function They antagonize the action of estrogen and progesterone on the uterine mucosa producing atrophy of the endometrium The action on the vaginal smear is variable the effects being either positive or negative The breast tissue may be depressed or stimulated As untoward reactions patients often note hirsuties hoarseness atrophic vaginitis clitoral enlargement a rapid weight gain an increase in libido and acne vulgaris

Androgens have been used therapeutically in the treatment of menstrual disorders and in the management of the menopause

The administration of 300 to 400 mg of testosterone propionate during the menstrual cycle in divided doses provides effective control of *profuse menorrhagia* and *metrorrhagia* Temporary amenorrhea may be continued for long periods with a return of the normal ovulatory cycle when treatment is discontinued In many cases there is a marked improvement in the functional bleeding (pp 2557 2565)

A dose of testosterone propionate of 150 to 500 mg in a single cycle starting not later than the sixth day of the cycle may afford complete relief from *dysmenorrhea* (p 2561)

The administration of testosterone propionate in doses of 25 to 50 mg three times weekly provides an effective means of alleviating the symptoms of the *menopause* The effect is associated with a decrease in the urinary gonadotropic hormone titer and the production of a normal estrus smear This therapy has been recommended in those cases that respond poorly to estrogens or in those in whom bleeding is excessive Since it i not physiological it is not a method of choice and should be used cautiously

Intramuscular injections of 10 mg of androgen given daily for four days usually suppress lactation in mothers who cannot take estrogen for this purpose (p 2516)

Anticarcinogenesis—Injections and transplants of androgen have been suggested in the treatment of carcinoma of the breast with and without metastases An occasional brilliant result is observed though by and large the results are disappointing

CHAPTER 119

THE FEMALE REPRODUCTIVE SYSTEM PATHOLOGIC PHYSIOLOGY

FUNCTIONAL abnormalities of the female reproductive system provide frequent problems for the general practitioner The disturbances may be hormonal menstrual ovulatory sexual or related to fertility

HYPOGONADISM

The commonest type of dysfunction of the ovary is hypogonadism which is responsible for a number of clinical states variously designated as hypogonadism hypogenitalism sexual infantilism sexual juvenilism and genital hypoplasia *It is a common cause* for *amenorrhea sterility obesity metabolic disorders* and certain of the *psychoses* and *psychogenic disorders* Gonadal deficiency may be primary in the ovary or may result from extragonadal endocrine and metabolic influences

PRIMARY HYPOGONADISM

Primary ovarian deficiency may be congenital or acquired The latter usually results from infection (mumps syphilis or gonorrhea) the growth of a neoplasm such as a dysgerminoma vascular disturbances incidental to pelvic infections or surgical castration

Clinical Manifestations —The clinical features of primary hypogonadism depend for the most part on the age of the individual at the onset of the defect and the degree of hormonal lack

Prepuberal Hypogonadism —Failure of ovarian function before the onset of puberty *leads to marked changes in body form* as well as in the development of accessory sex organs

tive findings Before rupture it is advisable to perform a laparotomy and remove pregnancy and tube After tubal abortion it may be possible to preserve the tube

OPERATIVE GYNECOLOGY

Gynecological operations are many and diverse It is the impression of the senior author that much gynecologic surgery is needless and meddlesome he does not sanction procedures in his practice unless there are clearcut indications For instance he does not favor plastic operations merely because a woman has a symptomless cystocele or a rectocele neither does he permit laparotomy merely because of the presence of fibroids of the uterus or a malposition he does not believe that distant symptoms arise *frequently from abnormalities of the female genitalia* and the association of backache asthenia and the like with retroversion of the uterus does not impress him as an example of cause and effect

TABLE 141 —OBSTETRIC AND GYNECOLOGIC OPERATIVE PROCEDURES

Procedure	*Remarks*
Circumcision	Of adherent hood covering clitoris for frigidity
Incision of hymen	For imperforate hymen and as premarital procedure
Excision of Bartholin gland	For chronic or cystic disease
Colpotomy	For drainage of pelvic abscess through vagina
Repair of perineum	Following birth injury
Anterior and posterior colporrhaphy	For cystocele and rectocele
Cervical biopsy	On suspicion of malignancy
Cauterization of cervix	For chronic endocervicitis
Trachelorrhaphy	For plastic repair of cervix
Excision of endocervix	For chronic endocervicitis
Amputation of cervix	For chronic endocervicitis
Excision of fistula	For repair
Dilatation and curettage	For diagnosis For therapeutic and incomplete abortion
Shortening of uterosacral ligaments	For malpositions of uterus
Shortening of round ligaments	For malpositions of uterus
Uterine suspension and fixation	For malpositions of uterus
Hysterotomy (cesarean section)	*In obstetrics*
Myomectomy	For uterine fibroids
Vaginal hysterectomy	For uterine fibroids malignancy and chronic infection
Subtotal hysterectomy (supravaginal)	*Removal of uterus with preservation of cervix*
Total hysterectomy	Removal of uterus and cervix
Panhysterectomy	Removal of uterus ovaries and tubes
Salpingectomy	Removal of tube with preservation of ovary May be unilateral or bilateral
Oophorectomy	Removal of ovary with preservation of tube May be unilateral or bilateral
Salpingo-oophorectomy	Removal of tubes and ovaries unilateral or bilateral
Ligation of tubes	For sterilization
Episiotomy	In obstetrics to preserve perineum
Forceps deliveries	In obstetrics

The actual technic of treatment is subject to considerable variation As a rule large doses of estrogen in the form of 2 to 5 mg of stilbestrol are given intramuscularly two or three times weekly for two weeks After an interval of two weeks treatment is resumed and is continued in cyclic fashion for several months when injections are stopped to determine whether or not the ovary is able to continue the menstrual rhythm established by the drug If spontaneous cyclic bleeding is not achieved the gonadotropic factor of pregnant mare serum (p 1154) is given in a course of 5 daily injections of 400 I U The gonadotropin is first administered on the eighth day after the calculated onset of menstruation

In some instances ovarian function has been restored to normal In others substitution therapy influences normal growth and mammary development and improves the patient s mental and physical condition The latter rather than the restoration of cyclic uterine bleeding is the principal therapeutic goal

THE MENOPAUSAL SYNDROME

Many women experience a variety of troublesome symptoms during change of life despite the fact that the climacteric is a physiological phenomenon The syndrome is apt to be most severe after surgical or roentgen castration

Clinical Manifestations—The principal clinical features of the menopausal syndrome are of vasomotor or psychic origin The former consist of hot flushes chilling tachycardia and palpitation The flushes or flashes often recur 30 or 50 times a day they are of short duration and are commonly accompanied by profuse sweats dizziness and fatigue In some women arterial hypertension (p 900) develops at this time and seems related in some way to the general endocrine upheaval Numbness tingling and other peripheral paresthesias are common and are believed due to local vasomotor disturbances

Changes in Psyche and Sexuality—Psychic difficulties are especially prominent in women who have a pre existent psychoneurosis Frank psychoses (p 1364) may be precipitated depressions and anxiety states are frequent nervousness irritability excitability faulty memory inability to concentrate and hypochondriasis are encountered Many women flaunt pre existent personality defects during this period Asocial women become mollusks while the dominant female bullies her loved ones who dare not cross her because of her condition Much of the anxiety stems from old wives tales which attribute to the cessation of the menstrual flow all manner of complaints ranging from frigidity and insanity to carcinomatosis

Profound changes in sexual behavior are to be expected Many women develop an aversion to intercourse sow the seeds of marital discord and encourage philandering by the husband Others freed from fear of pregnancy begin to enjoy sexual intercourse for the first time during this dangerous age ' In extreme instances libido becomes insatiable to the amazement and bewilderment of the husband

Associated Conditions—Objective manifestations of the menopause occasionally assume considerable clinical importance *Obesity* (p 695) is not uncommon and is related to decreased metabolic rate and physical

GENITAL MANIFESTATIONS—In prepuberal hypogonadism uterus vagina fallopian tubes mammary glands and body contour fail to develop normally the menarche is absent and ovulation does not occur The uterus is small and usually acutely anteflexed or retroflexed the cervix is long and narrow and constitutes about two thirds of the total uterine length as in the infant, the cervical os is of pinhole size the tubes are long and convoluted The vagina is short shallow and rigid and the anterior fornix is usually obliterated The external genitalia are small but in some mild instances may be normal in appearance The breasts are small and flat while the pelvis is narrow and male like

SOMATIC MANIFESTATIONS (EUNUCHISM AND INFANTILISM) —There is some variation in the effect of ovarian deficiency on somatic growth As a rule the female develops the counterpart of *eunuchism* in the male (p 2413) with accentuation of growth in height from delayed epiphyseal closure the length of the extremities is disproportionately great in comparison with the trunk On the other hand some patients show a general retardation of growth and *infantilism* (p 693)

ALBRIGHT S SYNDROME —A form of infantilism associated with congenital absence or malformation of the ovaries has been described by Albright It is marked by short stature scant axillary and pubic hair absence of secondary sex characteristics retarded bone age good nutrition and strength abnormally high urinary excretion of follicle stimulating hormone subnormal urinary excretion of 17 ketosteroids and a normal response to insulin Coarctation of the aorta webbing of the neck diffuse osteoporosis and premature senility are additional features Treatment with estrogen restores axillary and pubic hair growth and mammary development

Hypogonadism of Puberty and Adolescence—Patients whose ovarian deficiency develops in puberty and early adolescence may show few evidences of somatic change The defect is indicated almost entirely by infantile internal genitalia amenorrhea oligomenorrhea frigidity dyspareunia repeated abortion or sterility In some of these cases the urinary excretion of follicular hormone is normal To explain this paradoxical situation it has been suggested that derivatives of the mullerian ducts lose their responsiveness to estrogen due to an embryological defect or that several hormones other than estrogen are involved in genital stimulation The phenomenon of estrogen resistance has its counterpart in resistance to thyroid insulin and the posterior pituitary antidiuretic factor

Hypogonadism at Maturity—In the adult removal of the ovaries produces widespread changes in the reproductive and endocrine organs as well as the body as a whole Since growth is complete alterations in stature are not to be expected although acromegalic features may be encountered The clinical aspects of hypogonadism in the adult are discussed in the section on the *Menopausal Syndrome* (p 2525)

Treatment—The management of hypogonadism is determined by the age of the patient and the nature of the ovarian disturbance Treatment aims to initiate the natural cycle of follicular hormone stimulation of body tissue *Estrogen* (p 2513) is administered to produce a sufficient development of the pelvic organs to enable them to respond normally to endogenous ovarian hormone

senior author It is his present attitude that estrogenic therapy should be deferred as long as possible and then administered in the smallest possible doses for the least possible time Until there is satisfactory evidence that malignant growth can be neither initiated nor activated by the well intended use of the hormone the majority of patients will prefer to rely upon sedatives and hypnotics fortified by a certain amount of tolerance and equanimity

HYPERGONADISM

Hypergonadism may be manifest as pubertas praecox postmenopausal bleeding virilism or masculinization

PUBERTAS PRAECOX

A precocious puberty is of rare occurrence and usually signifies a pro found disorder most often the presence of a tumor involving ovary (p 2567) adrenal cortex (p 1278) or anterior pituitary gland (p 1175) The condition requires specialist investigation and drastic therapy

POSTMENOPAUSAL BLEEDING

Postmenopausal bleeding is most often due to organic disease such as the presence of a uterine or ovarian neoplasm or a chronic inflammation (p 2565) *If these conditions can be eliminated by physical examination* and diagnostic curettage it may be assumed that the disturbance is of functional origin arising from hypergonadism In many instances the latter condition is idiopathic but it may result from overzealous therapy with estrogen or excessive output of gonadotropic anterior pituitary hormone secondary to the presence of a neoplasm

VIRILISM AND MASCULINIZATION

A certain amount of maleness appears physiologically at the meno pause in many women who develop a tendency toward moustache and beard formation often with the appearance of bristly hairs requiring shav ing *This complication is regarded as an annoyance but nothing else* Sim ilar manifestations to a greater degree may result from androgen therapy (p 2520) Less often virilism or masculinization in the female is due to an arrhenoblastoma (p 2575) or a tumor of the adrenal cortex (p 1278) or anterior pituitary gland (p 1175)

DISLOCATION OF THE ANDROGEN ESTROGEN RATIO

Androgenic substances are present in the biological fluids of the female just as estrogen is demonstrable in the male (p 2418) When the ratio is disturbed on the side of a disproportionate increase in androgen the female shows a male hair escutcheon and a tendency to develop *acne vulgaris* (p 3358) The relationship of this biological phenomenon to the problem of homosexuality is under present investigation (p 2412)

DEFICIENCY OF PROGESTERONE

There is no clinical evidence that hypersecretory states exist with refer ence to progesterone Deficiency may be of some significance in the prob lems of *dysmenorrhea* (p 2561) *mastalgia* (p 892) and *habitual abortion* (p 2653)

inactivity Disorders of the endocrines are prone to occur in susceptible individuals *diabetes mellitus* (p 1246) is frequent the menopause being one of the peaks for the incidence of the disease *myxedema* (p 1193) and *hyperthyroidism* (p 1197) may initiate at this time, acromegaloid changes and frank *acromegaly* (p 1156) may occur

The various tissues undergo basic structural alteration In some women there is the rapid onset of *osteo arthrosis* (p 2855) associated with painful arthralgias (*menopausal arthritis*) A moderate degree of osteoporosis particularly of the spine is often seen and leads to radicular pain and kyphosis The skin tends to become dry atrophic and wrinkled and eczematoid lesions are frequent

Pruritus vulvae (p 2594) *kraurosis vulvae* (p 2597) and *senile vaginitis* (p 2600) are troublesome degenerative conditions that are occasionally encountered

Hormonal Changes—The menopause is characterized by absence of estrogen from the urine There may be an increased amount of pituitary gonadotropin due to overactivity of the master gland which attempts to stimulate the failing ovaries The increase in pituitary activity may be responsible for the onset of endocrine disorders at the time of the menopause as well as for certain of the clinical manifestations of the menopausal syndrome The administration of estrogen is usually followed by decrease in urinary excretion of pituitary gonadotropin

Treatment—Most women require some medical assistance at the menopause Mild psychic and emotional difficulties are easily controlled by sympathetic reassurance and the use of sedatives (p 3836) and hypnotics (p 3836) Persistent disabling manifestations require replacement therapy with estrogens (p 2513) The glandular preparation of choice is the synthetic diethyl stilbestrol or stilbestrol (p 2515) which is effective orally The usual dose varies from 0 25 to 1 0 mg daily as determined by symptomatic relief or objective changes in the vaginal smear (p 2495) A thoroughly satisfactory result consists in amelioration of discomfort and transformation of the vaginal secretion from the smudgy appearance of the menopausal epithelium to a phase where the cells are cornified with small pyknotic nuclei discretely arranged in a field that is free from debris and leukocytes The more elaborate indices of estrogenic effect are not required They include estimations of urinary estrogen level urinary titer of pituitary gonadotropic hormone and endometrial biopsy Those patients who fail to be relieved of their distress and whose vaginal smear remains unsatisfactory are given intramuscular injections of natural estrogens such as estradiol benzoate (p 2515)

Estrogenic therapy occasionally is associated with untoward symptoms Stilbestrol may produce nausea vomiting anorexia abdominal distress diarrhea lassitude eruptions and unusual thirst The presence of any of these manifestations calls for intramuscular injection of natural estrogen Estrogenic therapy is capable of inducing considerable uterine bleeding due to endometrial hyperplasia Should this occur the drug is discontinued and synthetic vitamin E (ephynal acetate) may be substituted in doses of 10 mg three times daily

The carcinogenic activity of estrogen in the experimental animal has caused considerable disquietude among many clinicians including the

CHAPTER 120

THE FEMALE REPRODUCTIVE SYSTEM: CONGENITAL MALFORMATIONS, INJURIES AND MECHANICAL DISTURBANCES

Congenital *anomalies of the female reproductive system are occasionally* encountered as causes of sterility, menstrual disorders and difficulties in the conduct of labor. The more usual malformations are due to arrest of normal development, persistence of an infantile condition, absence of a genital structure or the union of the two sexes in one individual producing the perplexing problem of hermaphroditism.

IMPERFORATE HYMEN

Imperforate hymen produces *cryptomenorrhea*. The condition may not be noted until the time of the menarche when symptoms arise as the result of obstruction to menstrual flow.

ABSENCE OF THE VAGINA

Absence of the vagina may be present despite the normal appearance of the external genitals. The malformation is of serious moment and requires consultation with the specialist since associated defects are often present.

DYSOVULATION (MITTELSCHMERZ)

The syndrome of dysovulation occurs 14 to 15 days before the onset of menstrual flow The condition is caused by rupture of the ovarian follicle and peritoneal irritation from the escaped fluid or the accompanying blood

Clinical Manifestations —In dysovulation the patient complains of *pain in the right or left lower quadrant* (pp 1866 1880) The distress is of varying severity, from a dull ache to a sharp pain Examination reveals local tenderness slight elevation of temperature and mild leukocytosis *If the patient has not had similar attacks* with suggestive regularity in relationship to the menstrual period, the condition is easily confused with an acute intra abdominal infection If the right ovary is involved acute appendicitis (p 1881) is simulated and operation is performed a normal appendix is removed and the ruptured follicle is observed in the affected ovary

The conscientious practitioner ought not be too greatly disturbed at the error of confusing dysovulation and acute appendicitis It is far better to remove unnecessarily a score of normal appendices than omit the diagnosis in a single instance which might threaten the life and health of the patient With left sided lesions greater conservatism is warranted though the clinical manifestations may closely resemble those produced by an acute diverticulitis (p 1868)

OVULATION BLEEDING

Ovulation bleeding refers to a periodic flow that occurs in the mid *interval of the cycle* at the time of ovulation It is usually manifested by spotting and bleeding for only a few hours or at most for one or two days It may be accompanied by the syndrome of *dysovulation* (p 2528) The condition suggests a reversion to the more primitive type of sexual cycles It resembles preovulatory bleeding in dogs and ovulatory bleeding in cows and monkeys

The condition does not require treatment but merely an explanation to the patient of the nature of the disturbance

HERMAPHRODITISM

Hermaphroditism is a disturbance of sexual differentiation in which *the structural features of both sexes are present in one individual*. *True hermaphroditism* is present in individuals who have both ovaries and testes. *Male pseudohermaphroditism* is marked by the presence of male gonads but female secondary sex characteristics; the *female pseudohermaphrodite* has male secondary characteristics and ovaries.

True Hermaphroditism.—True hermaphroditism is very rare and only nine authentic examples have been reported in the medical literature. The condition is usually not diagnosed until operation or autopsy since the individual possesses the mental and physical make up of one or the other sex. The true hermaphrodite does not develop full functional capacity of the gonads and is unable to procreate.

Male Pseudohermaphroditism.—Male pseudohermaphroditism is the commonest of this group of malformations. It accounts for about 80 per cent of all pseudohermaphrodites and is apparently familial. Individuals of this type have testes but their external and internal accessory sex organs and their secondary sexual characteristics resemble those of the female. During infancy and childhood they are usually regarded as females but with the onset of puberty male characteristics develop. The masculine contour, deepening of the voice and hirsutes suggest the presence of the abnormality. Such a person may marry, unaware of her maleness, and is often able to fulfill the female role sexually. As in the case of the true hermaphrodite the ability to procreate is lacking.

On physical examination the body is seen to have a masculine contour, the breasts are flat and hair distribution is of the male type; skin and muscles, however, have a female texture. The labia majora appear normal, clitoris is enlarged and resembles a penis and the urethral canal opens directly into the vestibule. The vaginal orifice may be normal or rudimentary; there may be no vagina or only a shallow one. In some instances the external genitals are clearly masculine from birth, the only evidence of sex reversal being a rudimentary vagina covered by a normal scrotum. In other patients there is a hypospadias scrotalis. In the higher degrees of intersexuality operation reveals sterile intra abdominal testes and male gonaducts.

Female Pseudohermaphroditism.—Female pseudohermaphroditism is marked by masculine sexual characteristics in a person with female gonads. The condition is comparatively rare as a developmental defect but a similar state may be produced by an *adrenal cortical tumor* (p 1278) or an *ovarian arrhenoblastoma* (p 2075). In the congenital type there is a masculine body contour and external genitals of the masculine type resembling those of male pseudohermaphroditism. The genitals have been mistaken for those of a hypospadiac male. The internal genitals are female and ovarian tissue is present. In several instances hypertrophy of the adrenal cortex has been observed.

In the more common acquired type the person starts life as a female. The presence of an androgen producing tumor effects a tendency to sex reversal. The fully developed syndrome of virilism is very similar to if not identical with that of the congenital pseudohermaphrodite.

The Nature of Hermaphroditism.—Considerations of the development of

The latter may include absence of cervix and uterus or an ectopic or absent kidney Treatment consists in the attempt to construct by plastic operation a suitable vagina

ATLASIAS OF THE INTERNAL GENITALIA

Absence of internal genitalia is usually not noted until operation or autopsy One or both ovaries may be missing particularly in monsters fallopian tubes may be absent or the site of congenital atresia the uterus may be missing or modified by failure of fusion of the embryonic mullerian ducts



Fig. 613—Double vagina and double cervix, due to independent development of two mullerian ducts following incomplete union There are two vaginal cavities each leading to its separate cervix uterine cavity and fallopian tube

UTERINE ANOMALIES

Uterine anomalies are due to complete or partial failure of the two mullerian ducts to complete their fusion In the *uterus didelphys* there are two cervices two narrow bodies and two tubes Should one mullerian duct fail to develop there results a *uterus unicornis* With a complete non union uterus and upper vagina are absent and the fallopian tubes end blindly Should the latter contain endometrium a variety of *cryptomenorrhea* is produced

Other uterine anomalies which are often observed only when difficult labor is encountered include *septal division* of the uterine cavity a *double cervix* or *septate vagina*

* Kelly H A., Operative Gynecology Vol 1 D Appleton Century Co New York

the reproductive organs and the determination of sex furnish an understanding of hermaphroditism In embryonic life there is a sexually indifferent stage of development the early gonad is bisexual containing both female and male elements Embryonic structures are formed that have their homologues in the adult reproductive organs of both sexes With differentiation of sex the organs of one sex undergo full development while those of the opposite sex persist as embryonic remnants

The mechanism of normal sex determination is fundamentally genetic residing in a chromosomal equilibrium or dominance established at the time of fertilization This is not however an absolute immutable influence so far as somatic sexual characters are concerned endocrine influences are capable of modifying the development of sex characters leading to intersexuality or sex reversal Hermaphroditism probably results from some combination of hereditary constitutional and hormonal factors that disturb the normal sexual balance

Treatment —The treatment of hermaphroditism is specialist province When the dominant sexuality has been determined plastic surgery may be used to approximate the normal for psychogenic effect and for the accomplishment of intercourse Hormone therapy may be attempted without great hope of significant result

CONGENITAL ABNORMALITIES OF THE BREAST

Congenital abnormalities of the breast are rare *Absence* of breast and nipple is rare but *accessory breasts* are sometimes seen usually along the mammary ridge from axilla to pubis Congenital anomalies of the *nipple* such as flat split or inverted structures may interfere with lactation

INJURIES AND MECHANICAL DISTURBANCES OF THE FEMALE REPRODUCTIVE ORGANS

For the most part injuries and mechanical disturbances of the female genitals are incidental to pregnancy and childbirth Less often the practitioner encounters penetrating wounds coital trauma foreign bodies impacted in the vagina and the miscellaneous physical afflictions common to all vulnerable structures

LACERATIONS AND PENETRATING WOUNDS OF THE VULVA VAGINA AND PERINEUM

Lacerations and penetrating wounds of vulva vagina and perineum may follow falls with impalement The hazard of these injuries is possible perforation of adjacent bladder rectum or peritoneal cavity Even in the absence of these complications the wound becomes contaminated with fecal *organisms of the gas producing variety*

Following injury most careful inspection is indicated The urine is examined for blood and visual examinations by vaginoscopy and proctoscopy are required

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penis and descent of one testicle *D* Section of ovary found with uterus and tube on left side Note follicle containing ovum *E* Section of uterus showing endometrium in the resting phase *F* Section of testicular tissue obtained by biopsy Tissue atrophic with no evidence of spermatogenesis

Lindvall S and Wahlgren F Virchows Arch Vol 297

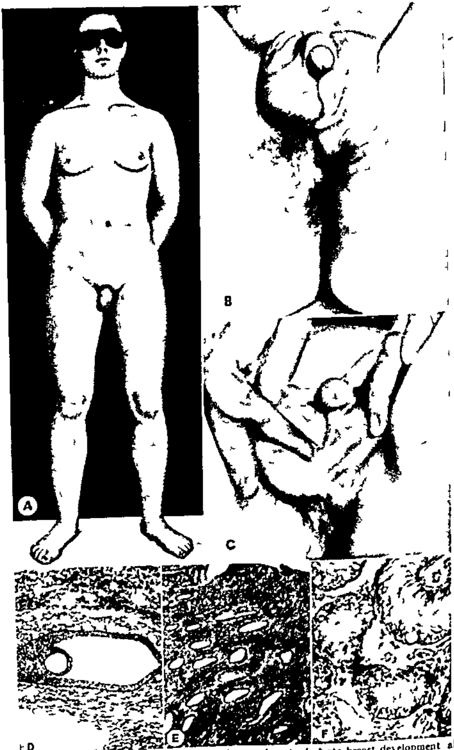


Fig 614—True hermaphroditism (gynandromorphism) *A* Note breast development absence of body and facial hair Blood noted in urine at monthly intervals since age of fifteen *B* and *C* External genitalia, showing insertion of sound into the urethral o in Note

It is to be differentiated from primary and secondary syphilis by darkfield examination (p 43) The condition is often associated with *trichomonal vaginitis* requiring microscopy of a hanging drop preparation (p 2598) The staining reaction with weak iodine as suggested by Schiller (p 2553) assists in the diagnosis of a superimposed or underlying malignancy which is best investigated by a biopsy

The presenting symptom of a cervical erosion is the presence of a yellowish white *leukorrhea* (p 2585) A vascular erosion may produce slight staining particularly after intercourse Vaginoscopy reveals a smooth red velvety appearance or a follicular shotty eroded surface about the external os

The cervical erosion usually yields to simple local therapy Epithelialization is stimulated by the application of 15 per cent silver nitrate or the use of the pure lunar caustic Should two applications fail to effect healing electrocoagulation or actual cauterization is indicated (p 2601) Coitus is avoided during the course of therapy

CERVICAL EVERSION OR ECTROPION

Cervical eversion or ectropion results from lacerations in which there has been a rolling out of endocervical mucous membrane Continued exposure of this surface results in the production of a chronic inflammatory reaction and leukorrhea

The ectropion is treated in the manner of a cervical erosion

STENOSIS OF THE CERVIX

Cervical stenosis may be partial or complete It may occur at any point between external and internal os The common etiologic factors include simple or venereal infection cauterization conization the insertion of radium trauma due to curettage an imperfect trachelorrhaphy or amputation postmenopausal atrophy or occlusion by a neoplasm

The cervical stricture or stenosis may be a cause of *sterility* (p 2492) and *dysmenorrhea* (p 2561) More or less complete occlusion results in hematometria or hematosalpinx with cryptomenorrhea

The condition may be alleviated by dilatation of the canal

RUPTURE OF A VAGINAL VARIX

Rupture of a vaginal varix occasionally causes profuse hemorrhage during or following childbirth Immediate treatment involves hemostasis by pressure or a transfixing ligature At times the varix bleeds internally and produces a para vaginal hematoma which requires evacuation

RELAXATION OF THE PERINEUM

Relaxation of the perineum is a common sequel of childbirth The tissues become lax and loose and the levator ani muscles appear stretched and separated The patient notes a feeling of bearing down Rectocele (p 2536) and cystocele are common accompaniments Sexual intercourse is unsatisfactory from the standpoint of both male and female Perineal relaxation is preventable by good obstetrical care prophylactic episiotomy (p 2693) and accurate approximation of tears immediately following delivery

Treatment requires expert consultation The laceration is filled with sulfonamide powder and penicillin is given parenterally (p 106) Anti tetanus and anti gas gangrene serums (p 297) are administered for prophylaxis

COITAL INJURIES

Coital injuries usually involve rupture of the hymen during deflora tion with resultant hemorrhage To avoid this difficulty many patients request premarital dilatation or surgical incision of the membrane Exces sive bleeding following rupture is readily controlled by the local applica tion of ice and by pressure Only in the rarest instances is it necessary to use a hemostatic suture

VAGINAL IMPACTION OF FOREIGN BODIES

Foreign bodies sometimes are introduced into the vagina by children or adults in the course of masturbation There is a resultant abrasion con tusion laceration or even perforation of vaginal walls Indwelling pessaries may be imbedded in the vaginal wall and require piecemeal extraction



Fig 615 —Cervical erosion with ectropion

HYPERTROPHY AND ELONGATION OF THE CERVIX

Hypertrophy and elongation of the cervix are occasionally seen in nulliparous women but usually occur in those who have borne several children They are often associated with prolapse of the uterus (p 2537)

The protrusion of the cervix through the vaginal introitus is a source of annoyance If the vagina is deep and the cardinal ligaments of the uterus are not too relaxed a high tracheloplasty or amputation of the cervix may suffice to correct the condition

PROLAPSE OF THE CERVICAL STUMP

Prolapse of the cervical stump occurs after supracervical hysterectomy when a preliminary relaxation of the cardinal ligaments of the uterus had been present A *parametrial fixation* operation as performed for uterine prolapse is indicated

CERVICAL EROSIONS

Cervical erosion appears about the external os as a red granular areola of varying size It may present varying stages of ulceration and healing

From *Research* Volume 5 G D Searle & Company courtesy of Dr Karl John Karnaky

The indication for operative repair of a rectocele is the degree of subjective distress that is engendered Symptomless herniations may be treated with skillful neglect

CYSTOCELE AND URETHROCELE

A cystocele is a partial hernia into vagina of base of bladder It is due to stretching and relaxation of the vesicovaginal septum with separation or weakening of the anterior leaf of the broad ligament It is commonly associated with injury or stretching of the urethral sphincter and surrounding fascial supports As relaxation of the fascial sheaths becomes more marked there is progressive increase in the degree of cystocele and sphincteric relaxation and the final production of a urethrocele

With cystocele there is frequency of urination due to the presence of residual urine in the hernial sac Infection is common causing cystitis (p 2342) and often spreading to the upper urinary tract Relaxation of the vesical sphincter causes *partial incontinence* which is usually manifest by the involuntary voiding of a small amount of urine on sneezing coughing laughing and sudden exertion The bladder symptoms are increased when the patient is up and about Conversely there is almost complete relief while lying down unless some complication has occurred In examining for a cystocele and urethrocele it is important to have the patient bear down while standing

A cystocele with or without urethrocele should be repaired *surgically* since the lesion tends to increase with the passage of time and constitutes a constant threat to the integrity of the urinary tract The urethrocele that is associated with urinary incontinence should be corrected surgically

ANTEVERSION AND ANTEFLEXION OF THE UTERUS

The normal uterus is directed forward (anteversion) and bent upon itself in anteflexion as a result of which the body lies almost at right angles to the long axis of the vagina Exaggeration of the normal anteflexion may be congenital but it occasionally follows operative procedures for retrodisplacement of the uterus This condition rarely causes clinical disturbances but may occasionally produce *dysmenorrhea* (p 2561) or *sterility* (p 2492) and require the introduction of a stem pessary

RETRODISPLACEMENTS OF THE UTERUS

Weakening and laceration of the uterine supports as a result of childbirth frequently disturb the normal anatomic relations of the uterus *Retroflexion* is a reversal of the normal cervico uterine angle and *retroversion* is the tipping backward of the entire uterus which still maintains its normal anteflexion In *retrocession* the anteflexed uterus is displaced posteriorly into the hollow of the sacrum *Uterine prolapse* involves descent of the womb into the vaginal canal As a rule uterine descent is associated with one of the various types of uterine displacement

Pathology—The abnormally situated uterus is often enlarged especially during the immediate postpartum period as a result of subinvolution The ovaries are prolapsed enlarged edematous and frequently adherent The pelvic veins are engorged and tortuous The bladder occupies a lower position in relation to the uterus and *cystocele* and *urethrocele* are commonly present In prolapse the cervix is infected and may present decubitus ulcers

PERINEAL LACERATIONS

Perineal lacerations are usually due to birth trauma and are designated by the depth of the tear *First degree injury* is limited to vaginal mucosa and is of minor import *Second degree tears* may involve the superficial perineal fascia of Colles triangular ligament levator ani and sphincter ani muscles *Third degree* or complete tear severs perineum and sphincter ani muscles passing from the vagina through the perineal body into the rectum

Simple incomplete lacerations properly repaired heal without incident In many instances however, weakening of muscles and fascia allows rec-

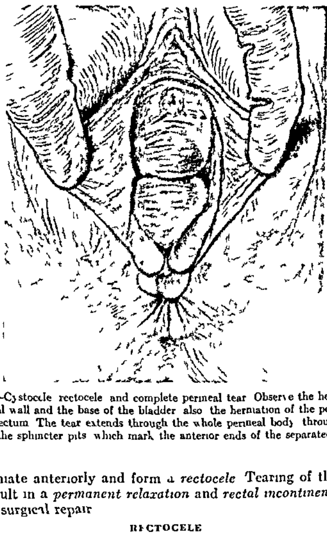


Fig 616—Cystocele rectocele and complete perineal tear Observe the herniation of the anterior vaginal wall and the base of the bladder also the herniation of the posterior vaginal wall and the rectum The tear extends through the whole perineal body through the sphincter ani Note the sphincter pits which mark the anterior ends of the separated sphincter ani muscles

tum to herniate anteriorly and form a *rectocele* Tearing of the sphincter ani may result in a *permanent relaxation* and *rectal incontinence* Stenosis may follow surgical repair

RECTOCELE

Rectocele is a herniation of the rectum into the vagina It may cause persistent aching pain and obstinate constipation Pressure from within the vagina may be required in order to empty the rectal pouch An *enterocele* resulting from a hernia in the cul de sac of Douglas may appear in the posterior vaginal fornix

E Broedel No 126 Courtesy of Dr T S Cullen

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Clinical Manifestations —The upright position does not favor the maintenance of normal uterine anteversion and anteflexion As a result at least one woman in six has a malposed womb although the vast majority report no clinical symptoms

The relationship of the retrodisplaced uterus to *back pain* is one that requires special emphasis Innumerable women have been subjected to operative procedures for the correction of malpositions of the uterus which supposedly produced low back pain (p 3072) Though many gynecologists maintain the relationship of symptom and findings it is the mature judgment of most internists orthopedic surgeons and practitioners that the causes of back strain are most often related to the skeletal system and its appendages Malpositions of the uterus as etiologic factors are so rare as to be virtually nonexistent

Uterine displacements may cause a feeling of weight or pressure in the pelvis and the lower back The patient complains that her pelvic organs are going to fall out *menstrual disorders* are common and are ascribed to the engorged edematous and prolapsed ovaries *menorrhagia* and *polymenorrhea* are frequent there is apt to be a profuse *leukorrhea* due to associated cervicitis and uterine congestion *dysmenorrhea* may accompany the cervical obstruction that occurs in some cases of *retroflexion* temporary *sterility* or delayed conception in the presence of retroversion may result from the anterior displacement of the cervix which no longer comes in contact with the vaginal pool of spermatozoa Retrodisplacements of the uterus favor spontaneous abortion with fixed retroversion the growing womb becomes incarcerated in the hollow of the sacrum and abortion terminates the pregnancy unless the abnormality can be corrected by gentle manipulation

The *retroflexed* uterus is recognized by the relatively normal position of the cervix while the fundus is felt in the cul de sac The fundus may be mobile so that replacement is possible or fixed by adhesions *Retroversion* is present when there is anterior displacement of the cervix and posterior position of the fundus *Descent* of the uterus is readily demonstrable by the ease with which the cervix is felt In *prolapse* the cervix may descend to the ischial spines (first degree) or the vaginal orifice (second degree) In third degree prolapse the whole uterus may extrude from the vagina

Treatment —Retroflexion and retroversion encountered during the post partum period may be corrected by simple measures such as corrective exercises (p 3757) or the use of a pessary

The Pessary —Pessaries are of great value in the conservative treatment of uterine displacements Their use is particularly indicated in young women shortly after childbirth in order to hold the uterus forward and facilitate normal involution Again they are of value in younger women who suffer from persistent retroflexion At any age the pessary is inserted as a diagnostic procedure since symptoms that are relieved by the temporary expedient may also be expected to yield to operative procedure The patient with prolapse or descent of the uterus who cannot be subjected to a surgical procedure for one reason or another also may be fitted with a supportive pessary

FOR UTERINE RETRODISPLACEMENT —Pessaries used for the purpose of correcting uterine retrodisplacements are modifications of the original

Hodge model which consists of two equal parallel bars joined by two S shaped parallel lateral bars The one straight bar is placed in the pos



Fig 617.—Replacement of the retrodisplaced uterus The cervix is pressed backward the body of the uterus lifted and pressed forward



Fig 618—Replacement of the retrodisplaced uterus Continued pressure with the vaginal finger together with lifting and forward pressure from without bring the uterus into position

terior fornix while the other rests behind the pubic symphysis The posterior bar raises the upper part of the vaginal wall holding the cervix back

in the hollow of the sacrum and projecting forward the fundus of the uterus Once the body is replaced anteriorly it is kept forward by the pull on the uterosacral ligaments Modern adaptations of the Hodge pessary include the A H Smith model with a longer posterior arm which presents more surface to the posterior vaginal fornix and a narrower grooved an

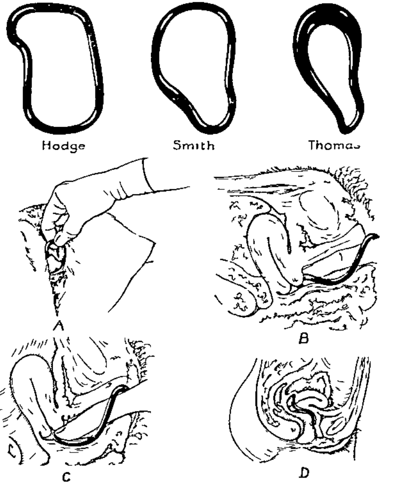


Fig 619—Ring pessaries and their introduction in the treatment of retrodisplacement. For introduction the perineum is depressed and the pessary is introduced through the vaginal opening its width lying in the anteroposterior diameter of the opening but turned somewhat obliquely to avoid the urethra *A* When the pessary has passed the opening it is turned so the width lies transversely then is pushed in until its further progress is stopped by the cervix *B* The index finger is passed to the top of the posterior end of the pessary *C* The posterior end is depressed and pushed past the cervix *D* The pessary in place The action of the pessary is to hold the posterior vaginal fornix and with it the attached cervix well backward and upward in the pelvis

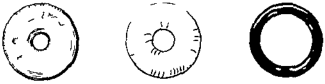
terior arm to fit the pubic arch and avoid pressure on the urethra The Thomas pessary is similar to the Smith model but has a thicker posterior bar

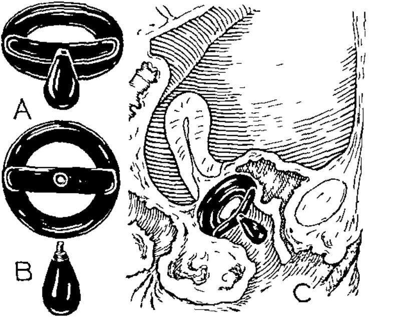
The size of the pessary is determined by measuring the distance from the posterior fornix to the pubic arch and estimating the apparent width

* Redrawn from Crossen and Crossen Diseases of Women 8th ed C V Mosby Co

of the vagina Proper fit is essential and reference to the gynecologist is suggested a small pessary fails to keep the uterus in position and may be spontaneously expelled one that is too large causes pain and irritation

No type of supportive therapy is indicated unless the uterus can be replaced in its normal position To introduce the pessary the patient is put in the gynecologic position and the anterior narrow bar is grasped while the perineum is depressed The device is inserted in the anteropos





F g 620—The Menge pessary *A* The pessary with the stem in place *B* The pessary with the stem detached from the r ng portion of the pessary pr paratory to introduction of the latter *After the ng portion has been introduced, the stem is fastened* in place as shown in C The stem l es in the vag nal canal, and keeps the ring from turning into any position that will allow it to sl p out

terior diameter of the vaginal slit When it is about halfway in the pessary is turned and the finger is shifted to the posterior bar which is pushed deep into the posterior vaginal fornix The anterior bar rests beneath the symphysis and the cervix lie within the concave opening After insertion the patient walks about and if there is no discomfort and the uterine replacement is maintained the pessary is properly fitted

Since pessaries produce vaginal irritation and a leukorrheal discharge

Red awn from Cr ssen and Crossen D seases of Women 8th ed C V Mo by Co

a daily douche of lukewarm water is advised The pessary is removed and cleansed once a month Failure to follow these precautions may lead to pressure necrosis with fistula formation and may predispose to the development of vaginal and cervical carcinoma

FOR PROLAPSE —Other types of pessaries have been devised for use in the treatment of uterine prolapse Their purpose is to keep the prolapsed

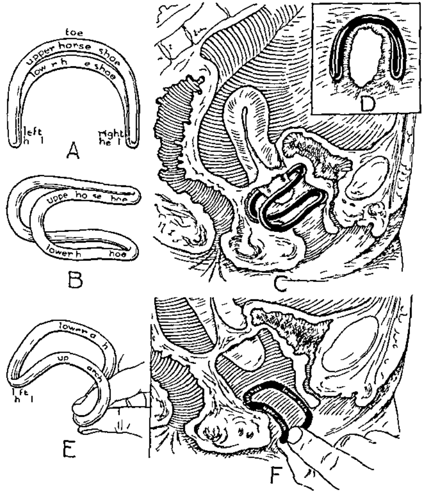


Fig 621 —The Gehrung pessary and its introduction *A* The pessary as viewed from above *B* The pessary as viewed from the side *C* The pessary in place showing the action of the upper arch in holding up the uterus and base of the bladder *D* Showing how the heel on each side indents the tissues some distance from the vaginal opening instead of pressing into the opening like a wedge as do other pessaries *F* How the pessary is held for introduction *F* First step in the introduction With the right heel held to the left side of the vulva, the left heel of the pessary is pushed into the vaginal opening as far as it will go *

organ in the vagina when surgery is contraindicated and prepare the tissues for a better surgical field by reducing edema and allowing infection to subside The type of pessary used depends on the degree of prolapse it should be chosen and fitted by a gynecologist

Ring pessaries are simple hard rubber rings or disks of value only in mild prolapse They tend to turn edgewise and slip out of the vagina The

* Redrawn from Crossen and Crossen Diseases of Women 8th ed C V Mosby Co

Menge pessary is a hard rubber ring with a detachable stem placed on a transverse bar in the center of the ring. This prevents the pessary from turning. The *Gehrung pessary* is a saddle shaped device with an upper and lower arch and a right and left heel. This is valuable in the management of prolapse attended by a marked cystocele. It is difficult to introduce. The *Gellhorn pessary* is a hard rubber disk with a central stem. It is a modification of the Menge pessary. It is of one piece construction, simple to remove and insert. A further modification is the *Emmert Gellhorn pessary* which has a hollow stem that facilitates drainage. The *cup and belt*

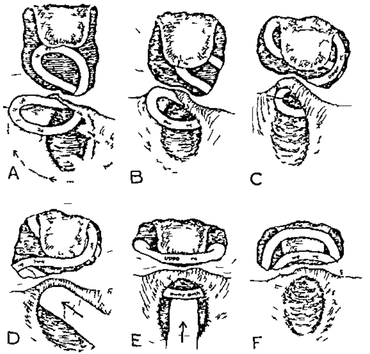


Fig 622.—Introducing the Gehrung pessary (*continued*). *A*, Swinging the right heel to the right side, which carries the left heel under the cervix to the left side and brings up the upper arch which was below. *B*, Pushing the pessary around the vaginal wall back of the cervix in order to get the right heel within the vagina. *C*, Further progress in the same direction. *D*, The right heel within the vagina and being carried to its position on the right side. *E*, The two heels situated symmetrically on each side. The arches are still too low. *F*, The arches pushed up into place back of the symphysis.

pessary consisting of a hard rubber cup with a long stem which is held in place by an abdominal belt and rubber cords may be used when there are no supporting pelvic tissues.

The pessaries used in prolapse, with the exception of the Gehrung, should be removed by the patient every forty eight hours to prevent pressure necrosis and for cleansing. Daily water or astringent douches must be taken.

Surgical Repair.—The indications for surgical correction of *retrodisplacements* of the uterus vary with the individual. Many gynecologists

Redrawn from Crossen and Crossen, Diseases of Women, 8th ed., C. V. Mosby Co.

regard the finding itself as sufficient excuse for repair They point out that continued mechanical disturbance is a predisposing factor in the development of endometriosis (p 2558) and functional and organic disturbances of the ovaries At the other extreme many internists and general practitioners oppose operative procedures unless there are definite subjective or objective manifestations that are clearly related and demand relief

A compromise between the extreme views would probably result in general agreement that operative correction is required if there are evidences of subinvolution of the uterus prolapse and congestion of the ovaries with pain and distress frequent or prolonged menstrual period persistent leukorrhea deformities of the cervix particularly if associated with endocervicitis and erosion persistent sterility repeated miscarriage or local complaints which are remedied when a pessary is inserted for the purposes of a therapeutic test

The indications for surgical intervention in *uterine prolapse* are wider Under these circumstances increase in symptoms and the onset of complications are inevitable when the patient is older and a less favorable operative risk Early repair is therefore by all odds the procedure of choice The type of operation to be performed rests with the consulting surgeon or gynecologist The risks are surprisingly slight and convalescence is usually smooth and uneventful In competent hands the late results are eminently satisfactory

INVERSION OF THE UTERUS

Inversion of the uterus is a serious but fortunately rare condition It differs from *prolapse* (p 2537) in that the uterus is turned inside out the endometrial surface presenting

Inversion of the uterus is a complication of obstetrics that requires consultation with the *specialist*

CERVICAL LACERATIONS

The cervix is often torn during labor In most instances the trauma is negligible and there is complete healing After a difficult labor however or when forceps are prematurely applied before complete cervical dilatation extensive bilateral lacerations may be observed They may extend laterally into the vaginal fornices and broad ligaments Such lacerations rarely heal spontaneously but commonly give rise to *chronic cervicitis* (p 2600) The patient notes local discomfort and the condition may cause sterility predispose to malignancy and favor miscarriage if not corrected surgically

GENITAL FISTULAS

Fistulous communications between genital canal and adjacent portions of urinary or intestinal tracts may follow birth injury The usual causes are pressure necrosis of the bladder wall by the child s head during delivery or injury to rectum or bladder from the application of forceps Improvement in modern obstetrical practice has largely eliminated the obstetrical factor in fistula formation The present day incidence is due chiefly to surgical procedures carcinomatous degeneration radium implants and trauma from foreign bodies such as pessaries

Urinary Fistulas—The varieties of urinary fistulas include vesicovaginal urethrovaginal ureterovaginal vesico uterine vesicocervicovaginal and urethrovesicovaginal They differ only in the path taken by the urine as it passes from bladder or ureter to vagina The commonest variety is the *vesicovaginal fistula*

Clinical Features—The chief manifestation of urinary fistula is chronic urinary leak from the vagina The amount varies from a few drops while standing or during excretion to a constant profuse dribble Vagina vulva and perineum are sore reddened and ulcerated There is a strong urinary odor about the patient she usually suffers intense psychic trauma and is made a virtual recluse

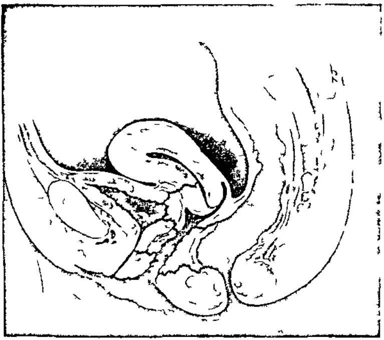


Fig 623—Schematic representation of genital fistulas (Ureteral and intestinal fistulas are not shown) *

The site of the fistula may often be seen by direct inspection with the patient in the Sims or the knee chest position Small fistulas are located by filling the bladder with a sterile solution of methylene blue and observing the point of leakage If a ureteral fistula is suspected cystoscopic examination is made

Treatment—Although vesical fistulas occasionally close spontaneously with or without continuous drainage with a de Pezzer catheter surgical intervention is usually necessary

Intestinal Fistulas—The common type of intestinal fistula is a *rectovaginal* communication Rarely an enterovaginal fistula is encountered after excessive radium treatment or as a complication of a vaginal hyster

* Curtis Textbook of Gynecology

ectomy Rectovaginal fistulas may complicate the repair of a simple or complete perineal laceration operations on pelvic abscesses and fistula in ano

Clinical Features—The principal manifestation of rectovaginal fistula is *rectal incontinence* with evacuation of feces into vagina With small fistulas only gas and liquid stool escape The diagnosis is made on inspection surgical repair or fulguration of the smaller tracts is required



Fig 694—Traumatic fat necrosis of the female breast showing the characteristic puckering and skin attachment A tumor is present possessing all the clinical signs of cancer This benign tumor resulted from the introduction of hypodermoclysis needles beneath the breast

BREAST INJURIES

Injuries to the breast are greatly feared by most women who regard trauma as a carcinogenic agent There is no evidence to sustain this view and the anxiety of the patient may safely be allayed

Traumatic Fat Necrosis—Traumatic fat necroses are observed when there has been severe injury to a heavy breast Lymphocytic infiltration with giant cell formation is encountered after a few weeks Later extensive fibrosis and calcification produce a stony hard *tumor* which resembles a cancer (p 2581) in that it is attached to the skin retracts the nipple and deforms the breast The condition requires complete excision for histological study and assurance as to its benign nature

* Adair in Christopher Textbook of Surgery

CHAPTER 121

THE FEMALE REPRODUCTIVE SYSTEM: CYSTS AND NEOPLASMS (INCLUDING THOSE OF THE BREASTS)

THE female reproductive organs including breasts are common sites for the development of cysts and benign tumors. Rarely if ever do these impair the health or threaten the life of the woman but the practitioner is constantly haunted in his everyday practice by the specter of malignancy which so commonly involves uterus ovaries and female breasts. Despite carefully gleaned differential criteria only histologic examination of excised specimens serves to relieve the mind or confirm the dread suspicion.

VULVOVAGINAL CYSTS

Vulvovaginal cysts are encountered with a fair degree of frequency. *Sebaceous cysts* usually occur on the labia. *Hydradenomas* are small white subcutaneous or pedunculated polycystic tumors derived from the sweat glands and easily removed under local anesthesia.

Inclusion cysts, the size of a pea to a cherry, occur at the lower end of the posterior vaginal wall. They arise from the mucous membrane that becomes submerged following perineal incision or laceration. They are lined by stratified squamous epithelium and usually contain sebaceous material. Simple excision under local anesthesia is performed with ease.

Cysts of Gartner ducts are derived from vestigial remnants of the *wolffian* ducts and arise from the anterolateral aspects of the vagina. They may be small or large, sometimes extending into the broad ligaments. They are lined by low cuboidal, high columnar ciliated or nonciliated or

DIFFERENTIAL DIAGNOSIS OF

Disturbances of Perineum, Vulva, and Vagina

The perineum vulva and vagina may be the sites of dermatoses infectious proces es traumatic disturbances cyst formation neoplasm and changes due to the endocrinopathies In the investigation of any of the e the practitioner is justified in entertaining a high index of su picion relative to the venereal diseases He owes it to the patient and to his own reputation to conduct complete examinations for the purpose of corroboration or negation of this hypothesis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Infestations	Pediculosis pubis and scabies (p 2593) Identify parasites
Venereal Infections	Primary and secondary syphilis Perform dark field microscopy (p 45) Tertiary syphilis with positive Wassermann and response to iodide Lymphopathia venereum with positive Frei test (p 2591) Granuloma inguinale with identification of Donovan bodies (p 2592) Chancroid with isolation of H ducreyi (p 2588) Gonorrhea with gram negative diplococci recovered from vaginal secretion or urethral or cervical discharge (p 2587)
Non venereal Infections	Furunculosis Folliculitis (p 2595) Herpes zo ter and simplex with characteristic vesicles (p 2592) Condylomata acuminata (p 2595) Trichomonas vaginalis (p 2598) Identify protozoa in direct spread (p 2599) Non specific vulvitis and vaginitis
Allergies	Contact dermatitis from diapers napkins or panties (p 2595) Urticaria and angioneurotic edema with therapeutic response to epinephrine (p 3877)
Physical and Chemical Injuries	Dermatitis from pressure of clothing or local applications (p 2595) Intertrigo of fungus or monilial origin (p 2593) Elongated or adherent clitoris Rigid or intact hymen Hematocolpo or hematomas Lacerations fissures and fistulas Impacted foreign bodies including pessaries Rupture of vaginal varix (p 2535) Cystocele and rectocele (p 2536)
Cysts and Neoplasms	Sebaceous cysts of labia (p 2547) Hydradenomas of vulva (p 2547) Inclusion cysts on posterior vaginal wall (p 2547) Gartner cyst on anterolateral vaginal wall (p 2547) Bartholin cy t in lower third of labium (p 2549) Melanomas sarcomas carcinomas and melanosarcomas of vulvovaginal region (p 2549) Get biopsy and excise Consider x ray therapy
Endocrinopathies	Senile vaginitis leukoplakia and kraurosis vulvae (p 2597) Look for precancerous changes Consider estrogen therapy (p 2515)
Psychogenic	Vaginismus

CONTINUED

Analogues of Dermatoses	Psoriasis with scaling lesions as observed elsewhere (p 2594) Lichen planus with itching violaceous plaques as observed elsewhere (p 2595) Seborrhea (p 2595)
Vascular Disturbances	Rupture of vaginal varix (p 2535) Elephantiasis in all edematous conditions and in filariasis (p 3321)

squamous epithelium Excision should be performed under general anesthesia Quite similar to the Gartner cysts are the *cystic dilatations of the canal of Nuck* the closed off end of the sac of an inguinal hernia

Cysts of Bartholin s glands usually result from closure of the ducts following inflammation which is frequently but by no means always of gonorrheal origin (p 2586) Bartholin cysts are oval and are situated in the lower third of the labium majus Excision under local or general anesthesia is advisable

BENIGN TUMORS OF THE VULVOVAGINAL REGION

Benign tumors of the vulvovaginal region are rare They include fibromas fibromyomas adenomyomas and lipomas They are usually discovered accidentally and require surgical excision for histologic examination

SARCOMA OF THE VAGINA

Sarcoma of the vagina is a very rare tumor which may occur at any age The grape-like variety (*sarcoma botryoides*) seen in early infancy *or childhood arises from the vaginal vault or wall This neoplasm is a* mixed or teratomatous tumor which is highly malignant Radiotherapy may be instituted without great promise of success

MELANOMA OR MELANOSARCOMA OF THE VULVA

Malignant pigmented tumors of the vulva ordinarily have their origin in a black mole They are highly malignant Rapid fatal termination is inevitable despite combined surgical and radium therapy

CANCER OF THE VULVOVAGINAL REGION

Carcinoma of the vulva occurs in elderly women in association with *leukoplakia* or *kraurosis vulvae* (p 2597) Common sites for the lesion are labia majora prepuce of clitoris and vestibule Occasionally an adenocarcinoma arises from a Bartholin gland a sweat gland the clitoris or just within the urethral meatus The growth begins as a small itching and moist ulcer which slowly becomes larger indurated and hypertrophic Microscopic examination reveals a squamous epithelioma Inguinal and pulmonary metastases occur early

Primary carcinoma of the vagina *is extremely rare* It may be of the squamous cell variety or adenocarcinomatous arising from vestigial Gartner duct cysts Usually the posterior vaginal wall is involved with ulceration producing bleeding The lesion may penetrate into the rectum

Treatment—Thorough dissection of the lesion superficial and deep inguinal and femoral lymph nodes may be attempted with postoperative roentgen therapy The tumors are radioresistant and the *prognosis is poor*

NABOTHIAN CYSTS OF THE CERVIX

Nabothian or retention cysts arise from occlusion of pseudomucinous glands lining the endocervix They impart a hard or shotty feel to the cervix suggestive of malignancy Small cysts need not be disturbed except for biopsy Large cysts are pierced or obliterated by the electrocautery or coagulating current



Fig 625 —A case of endocervicitis with Nabothian cysts showing the chronic inflammatory reaction of the endocervical columnar epithelial cells and interstitial tissue, with resulting closure of the glandular ducts *

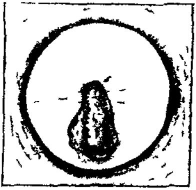


Fig 626 —Cervical polyp These growths produce slight bleeding They occur in women with chronic cervicitis †

CERVICAL POLYPS

Cervical polyps originate from the endocervical canal or the junction of columnar epithelium of endocervix and squamous epithelium of the portio They appear as pedunculated soft growths of varying size and they frequently protrude through the external os They may give rise to sterility and following coitus or vaginal examination to intermenstrual spotting or contact bleeding If situated high in the cervical canal they are not visible through the speculum Rarely a cervical polyp shows carcinomatous change

* From *Research* Volume 5 G D Searle & Company courtesy of Dr Karl John Karnaky

† Curtis Textbook of Gynecology

Polyps can be removed in the office After the cervix is prepared an open forceps is applied high upon the pedicle and the polyp is removed by a twisting motion Slight bleeding is controlled by pressure or vaginal gauze which may be retained overnight If bleeding is excessive the stump of the polyp is cauterized

CERVICAL FIBROIDS

Fibromyomas arising from the wall of the cervix are relatively rare Most often they are associated with multiple fibroids of the corpus (p 2554) the direction of growth is usually retroperitoneal toward the pelvis When large they may cause compression of bladder or rectum Occasionally they assume a more pedunculated form extending toward the vagina Surgical removal is often technically difficult due to their situation in the pelvis in relation to the ureters and bladder

CANCER OF THE CERVIX

Cancer of the cervix the commonest form of genital malignancy in the female comprises about 25 per cent of all carcinomas in women and 80 per cent of genital malignancies Annually 13 000 women die of the disease in the United States The successful treatment of this neoplasm depends on early recognition by the practitioner

Pathogenesis—Cervical carcinoma has its maximal incidence toward the latter part of the childbearing period although it may occur in women from twenty to eighty five years of age It is more common in parous than in barren women suggesting that trauma to the cervix as a result of parturition favors malignancy The sequence of events may be initial cervical erosion and laceration chronic cervicitis ectropion of the endocervical mucosa metaplasia of the covering layer of columnar epithelium and malignant change resulting from long continued epithelial imbalance and glandular hyperactivity The pathologic basis for this sequence is the fact that most cancers of the vaginal portion of the cervix arise at the margin of a *cervical erosion or at a mucocutaneous junction where columnar meets* squamous epithelium at the external os

In all likelihood leukoplakia of the cervix is also a precancerous condition Patches are found on the vaginal aspect of the cervix and may be demonstrated by Schiller s test (p 2553)

Pathology—The principal varieties of cervical cancer are *squamous cell carcinomas of the external cervix* and *adenocarcinoma of the endocervix* Each of these lesions may be nodular ulcerative or proliferative The nodular type is rarely seen since ulceration and *fungation occur rapidly*

Ulceration usually appears first in the region of the external os and extends over the vaginal surface of the cervix producing a foul crater which may start within the os and excavate the entire cervix The tumor is soft vascular and highly invasive The extent of cervical involvement cannot be judged on external examination Growths arising within the cervical canal tend to invade *deep tissues and produce extensive* ulceration of endocervix They may be extensively honeycombed before there is an external lesion

The growth of cervical carcinomas is rapidly progressive Local extension is common the vaginal vault is frequently involved and submucous extension along the anterior vaginal wall [illegible] n n 5 per cent of the patients From the upper part of the vagina there may be anterior and posterior spread to bladder [illegible] ctum and *pouch of Douglas* Rectovaginal and

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Group IV Vagina extensively involved with invasion of adjacent viscera and pelvic metastasis the condition is hopeless

Clinical Manifestations —Recognition of cervical cancer while the disease is still operable is only possible if *vaginoscopy* and *digital exploration* are included in the routine physical examination of every female of cancer age The main finding is an area of friable tissue which bleeds easily In its earliest stage a small elevated and firm induration is observed Later the lesion becomes papillary bleeds easily or forms an ulcer The area may be obscured by a surrounding zone of cervical erosion In later stages a large ulceration or a papillary mass fills the vault of the vagina and the lateral fornices are thickened indicating extension to the broad ligaments

The commonest presenting symptom is intermenstrual postmenopausal or post examination bleeding Occasionally bloody vaginal discharge follows coitus defecation or severe exertion The amount of blood loss is variable there may be a few drops spotting or profuse flow Occasionally there is an irritating leukorrhea which is blood stained A foul odor indicates secondary infection The practitioner must not forget that cancer may develop in the cervical stump following supravaginal hysterectomy

Diagnosis —The diagnosis of malignancy of the cervix is established or refuted by histologic examination of biopsy material The clinical lesion may resemble a simple cervical erosion endocervicitis cervical polyp primary syphilis or an ulcer resulting from any one of a variety of causes The Schiller test in which the cervix is painted with Gram s Iodine Solution has some presumptive value when a white unstained area due to a lack of glycogen is noted in the presence of a precancerous or malignant lesion However frequent biopsies should be made even at the risk of a large number of unnecessary procedures The policy of waiting until the pathognomonic clinical manifestations are apparent jeopardizes the chances of cure

Treatment —Cancer of the cervix requires expert management Except in very early lesions when surgical extirpation is still technically feasible radiotherapy is the procedure of choice Those who practice radical surgery favor operative removal of uterus adnexa broad ligaments and regional lymph nodes (Wertheim s panhysterectomy) Proponents of irradiation argue that extensive dissemination is apt to follow overzealous operative interference Our personal preference is adequate *surgical removal* of tissue in Group I followed by *radiotherapy* but the latter alone is advised for Groups II III and IV A guarded prognosis is justified since cures are to be anticipated in no more than 20 to 50 per cent under optimum conditions of early diagnosis and expert therapy

SARCOMA OF THE CERVIX

Sarcomas of the adult female cervix are unusual although *myosarcomas* may originate within normal fibromuscular tissue or within a cervical fibroid These lesions are treated by panhysterectomy (p 2522) followed by *radiotherapy*

Sarcoma botryoides a mixed tumor of the cervix is occasionally observed in infants and children Vaginal bleeding calls attention to soft grapelike polypoid masses that extend down into the vagina and through the introitus

vesicovaginal fistulas are frequent Lateral extension causes induration of the broad ligaments and cervical fixation upward extension involves the uterine body With bilateral urethral obstruction there are *hydronephrosis* and *renal insufficiency* Extension beyond the pelvis leads to involvement of lumbar and iliac lymph nodes and widespread metastases to lungs liver kidneys and bones



Fig 627—Epidermoid carcinoma of the external cervix (portio carcinoma) Epidermoid carcinoma and adenocarcinoma have no gross characteristics which serve to distinguish one from the other



Fig 628—Extensive epidermoid carcinoma of the external cervix (portio carcinoma) The cervix enlarges moderately—not often to greater than double normal size

A clinical classification adopted by the League of Nations Carcinoma Committee is as follows

Group I Growth limited to cervix uterus is mobile without paracervical induration the lesion is operable

Group II Growth has spread to some portions of the adjacent vagina with or without some induration of the cervical parametrium the lesion may be operable

Group III Partial or complete fixation of the uterus with thickening of one or both cervical parametria and involvement of the vagina the lesion is inoperable

rise to an *intraligamentous* tumor Occasionally a pedunculated subserous fibroid loses its connection with the uterus and becomes attached as a *parasitic fibroid* to the great omentum or some other intra abdominal structure

The presence of one or more large intramural fibroids is associated with hypertrophy of the body of the uterus and elongation and distortion of the uterine cavity The endometrium may be atrophic or hypertrophic depending on its relation to the tumor Atrophy results from compression by a tumor which projects into the cavity hypertrophy is seen chiefly in the marginal recesses which form around projecting submucous fibroids Submucous fibroids may become pedunculated and project into the vagina where the surface undergoes squamous metaplasia In patients with large tumors the ovaries are usually enlarged edematous and polycystic

On gross examination fibroids have a characteristic appearance They are usually multiple tend to assume a spherical shape and are easily differentiated from normal uterine muscle Curtis depicts them as "a group of nodules buried in the uterus quite similar to the lumps that one sees on a monster potato" They stand out sharply by virtue of their pallor against the red background of uterine muscle The typical growth is composed of interlacing muscle bundles which produce a whorled appearance Intramural tumors do not possess a definite capsule but may be shelled out of their muscle bed The main blood supply enters at one point on the circumference of the tumor and constitutes a vascular pedicle Tumors vary widely in size from small seedlings to large irregular growths that completely fill the abdominal cavity and may weigh 30 or more pounds

Histologically fibroids consist of a mixture of smooth muscle and fibrous tissues The muscle cells tend to form interlacing bundles and are prominent in younger tumors There are comparatively few blood vessels which accounts for the gross pallor

Degenerations in Fibroids—Degenerative changes in fibroids are common and are of considerable clinical importance They are nutritive in origin and result from interference with the blood supply to the tumor

Hyaline degeneration is the most frequent change and is seen to some extent in all fibroids The tumor becomes paler firmer and more translucent in certain areas due to compression atrophy of muscle bundles and collagenous fibers areas of liquefaction appear in the hyaline areas and the tumor becomes extensively honeycombed *Cystic change* is a more advanced form which results in large subserous tumors from gross liquefaction of advanced hyaline degeneration With *mucoid degeneration* characterized by the filling of necrotic spaces with a *pseudomucinous fluid* the whole tumor becomes soft

After the menopause *calcification* frequently supervenes in areas of necrosis it may be peripheral or irregular in its distribution *Red degeneration* is usually encountered during pregnancy the *hemolytic variety* is the more common and has been ascribed to the action of lipoids liberated by degeneration of tumor cells *Infarctive carnal degeneration* results from sudden occlusion of the blood supply in the actively growing pregnant uterus Red degeneration is not uncommonly followed by a *colon bacillus infection* abscess formation and peritonitis

Malignant degeneration of fibroids is rare occurring in less than 1 per cent of patients muscular elements are usually affected producing a *leiomyosarcoma*

Clinical Manifestations —In the majority of instances the fibroid tumor is encountered as a chance finding during routine physical examination It is rare for these growths to produce subjective symptoms until they have been present for many years Subserous and intramural myomas are easily delineated by bimanual palpation Submucous growths are impossible to feel and the usual first evidence of their presence is *menorrhagia* (p 2557) *dysmenorrhea* (p 2561) or *metrorrhagia* (p 2565) The passage of clots may attract attention or the growth may be encountered in the investigation of *sterility* or *repeated abortion* (p 2653)

Large tumors which produce pressure on adjacent structures give rise to a feeling of *heaviness* (bearing down sensation) in the lower abdomen or to urinary frequency incontinence or obstruction Encroachment upon the rectum results in constipation or pain on defecation

The *diagnosis* of cervical sarcoma is made by biopsy *Treatment* usually is ineffective since complete surgical excision cannot be accomplished and intensive radiotherapy yields unsatisfactory results

UTERINE MYOMAS (FIBROIDS)

The most common benign uterine tumor is the myoma or fibroid Approximately 20 per cent of women over the age of thirty five present multiple growths of this type The incidence is higher among Negroes in whom extremely large tumors are common Eighty to 90 per cent of fibroids



Fig 629 —Subperitoneal submucous, and intramural myomata of the uterus

occur from the third to fifth decade during the period of sexual activity they seem not to arise before puberty and after the menopause they tend to undergo atrophy Many of the known facts suggest a hormonal basis for the etiology of this neoplasm

Pathology —Fibroids are classified in accordance with their anatomical location a useful distinction from the clinical viewpoint since the symptoms are often determined by the situation of the tumor *Submucous intramural* and subserous myomas are recognized. Submucous and subserous varieties are pedunculated or sessile they commonly arise in the body of the uterus and are relatively infrequent in the cervix Extension into the broad ligaments gives

Kelly Cullen

curettage is required with a slight increase in risk discomfort and the period of hospitalization myomectomy or hysterectomy can be performed The surgical procedure spares rather than destroys the ovaries and post operative hypogonadism (p 2523) is less severe than that which follows irradiation

DIFFERENTIAL DIAGNOSIS OF

Menorrhagia

Menorrhagia refers to prolonged or profuse menstrual bleeding It is to be distinguished from polymenorrhea or frequent periods and from metrorrhagia in which the vaginal bleeding is independent of the menstrual cycle (p 2565)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	In the newborn
Pharmacodynamic	From prolonged or excessive dosage of estrogen (p 2515)
Psychogenic	*Associated with fear emotional stress and fatigue*
Hormonal	Metropathia hemorrhagica from hyperestrogenism at puberty and the menopause (p 2480) Exclude malignancy by biopsy or curettings if necessary Hypothyroidism with low B M R and relief from thyroid extract. Severe hyperthyroidism with elevated B M R and therapeutic responses to iodides and/or Deracil (p 1197)
Circulatory	Backward failure with other evidences of congestion (p 941) Local vascularity due to ascites or a large pelvic tumor Consider abdominal paracentesis (p 1920) and exploratory laparotomy
Hematologic	Blood dyscrasias characterized by generalized bleeding (p 1085) Check hemogram bleeding and coagulation times and platelet count (p 3692)
Gynecologic	Pelvic inflammatory disease (p 2608) Uterine polyps fibroids or malignancy (p 2562) Get biopsy or diagnostic curettage Malpositions of the uterus (p 2537) Endometriosis (p 2558) Consider laparotomy Cystic or malignant disease of ovary (p 2570) Confirm vaginal findings by exploratory laparotomy

Myomectomy —The surgical possibilities are myomectomy or hysterectomy Myomectomy is reserved for young women desirous of becoming pregnant The tumors may interfere with fertility increase the incidence of abortion affect labor and increase postpartum complications After preliminary dilatation and curettage each tumor is removed from its bed and the resultant cavity is closed The patient *should not become pregnant* for at least nine months

The uncomplicated fibroid rarely produces pain The relationship of uterine growths to *low back pain* is elsewhere discussed (p 3072) but it is here restated that the association of the two conditions is rarely more than coincidence The woman with low back pain may have a fibroid uterus but, unless the tumor is extremely large some other cause for her distress should be sought (p 3072)

Degeneration within a fibroid may cause localized abdominal pain or tenderness signs of peritoneal irritation slight pyrexia and an increase in sedimentation time Prolonged or repeated bleeding produces *secondary anemia* (p 1064) that sometimes reaches alarming degree Sudden excruciating pain suggests possible torsion of the pedicle of a pedunculated growth *Red degeneration* during or following pregnancy may produce acute localized abdominal pain and sharp elevation of temperature With secondary infection or peritonitis more urgent manifestations become apparent

Hypertensive cardiovascular disease (p 900) is observed more often in patients who have fibroids of the uterus The nature of this association is unknown unless hormonal factors are concerned in a manner that transcends present knowledge

Diagnosis—Recognition of a fibroid uterus rests upon typical physical findings Small submucous growths may not be detected until a diagnostic curettage is performed in order to determine the cause of uterine bleeding or of sterility On rare occasions large impacted fibroids produce ascites requiring exploratory laparotomy for the relief of symptoms and clarification of the diagnosis (p 1921)

Treatment—The treatment of uterine fibroids is dependent upon several variables which include the size of the tumors their location the extent of subjective symptoms and objective disturbances the patient's age and her desire for children Small symptomless fibroids are treated expectantly and periodic examinations are conducted every six months In women near the menopause symptomless tumors of moderate size require no treatment since they tend to regress after the climacteric

Indications—In general *active treatment* is indicated under the following circumstances (*1*) The tumor mass exceeds in size a three months pregnancy (*2*) multiple nodules are present (*3*) uterine bleeding is frequent or excessive (*4*) secondary anemia has developed (*5*) signs of peritoneal irritation suggest degenerative changes (*6*) pressure signs develop relative to the urinary tract rectum or low back (*7*) there are evidences of growth particularly at the menopause when regression is expected (*8*) there is fear of malignancy and the patient feels that the sword of Damocles hangs over her head

Roentgen Therapy Versus Surgery—When the decision to proceed with active treatment has been reached the technical aspects are discussed in relation to radiotherapy and surgery The former by producing an artificial menopause causes fibroid tumors to shrink its advocates emphasize that the method has no risk does not require significant hospitalization is safe and efficient and can always be followed by surgery if necessary Radiotherapy must be preceded by diagnostic curettage

Those who favor surgical extirpation in which category we are counted hold that radiologic therapy masks but does not remove the disturbance

curettage is required with a slight increase in risk discomfort and the period of hospitalization myomectomy or hysterectomy can be performed The surgical procedure spares rather than destroys the ovaries and post operative hypogonadism (p 2523) is less severe than that which follows irradiation

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Hysterectomy—Hysterectomy may be complete or supra cervical A nulliparous woman with a normal cervix is suitable for subtotal hysterectomy but a multipara with cervical erosions should have the more complete operation since carcinoma may develop in the cervical stump At operation the surgeon attempts to preserve enough ovarian tissue to prevent or minimize the symptoms of the *menopausal syndrome* (p 2525)

UTERINE POLYPS

Uterine polyps may occur alone or in conjunction with the cervical variety (p 2551) They produce similar disturbances and require operative removal by dilatation and curettage

ENDOMETRIOSIS (ADENOMYOSIS) AND CHOCOLATE CYSTS OF THE OVARY

Islands of ectopic endometrial tissue are frequently demonstrable within the uterine wall and in the pelvic cavity The condition of endometriosis is found in 5 to 10 per cent of all wombs removed for myomas or other types of diffuse enlargement It is encountered with considerable frequency in extra uterine pelvic organs and in the pelvis Estimates place

TABLE 142—RELATIVE FREQUENCY OF ENDOMETRIAL LESIONS IN 576 CASES (AFTER MASSON)

Uterus	482
Ovary	77
Rectovaginal septum	20
Ligaments of the uterus	19
Sigmoid	14
Pelvic peritoneum	24
Ileum	2
Fallopian tube	22
Vaginal wall	10
Appendix	1
Bladder	2
Abdominal wall	10
Umbilicus	6

the frequency of pelvic endometriosis between 9 and 21 per cent of all laparotomies

The Distribution of Endometriosis—Ectopic endometrium was found in the following distribution in 576 patients studied by Masson whose figures correspond closely to those presented by others

Endometrial implants have also been reported in labia inguinal region and pelvic and inguinal lymph nodes As a rule these lesions occur in more than one organ in each patient Uterine endometriosis is commonly associated with extra uterine implants

Etiology—Endometriosis of the uterine wall (adenomyosis) is due to direct penetration of the myometrium by epithelial tissue derived from the endometrial lining The condition is observed with greater frequency following childbirth and uterine infection but an appreciable number of instances have occurred in those who have never conceived or been infected

The most likely explanation of the phenomenon of endometriosis is that which hypothecates implantation and secondary growth of detached endometrial tissue Fragments of mucosa escape from the fallopian tube

by retrograde menstruation and develop wherever they attach themselves The ovary is most commonly involved because of its proximity and its ability to sustain these fragments Mechanical implantation may occur after curettage tubal insufflation and in the scar that follows any operative procedure involving uterine endometrium

Retrograde menstruation does not explain the lesion in such structures as bladder umbilicus labia and inguinal glands Spread to these areas may take place by way of lymphatics and venous sinuses since menstrual blood may actually penetrate vessel walls The lodging of endometrial fragments in the blood vessels of the uterine wall may be the agency by

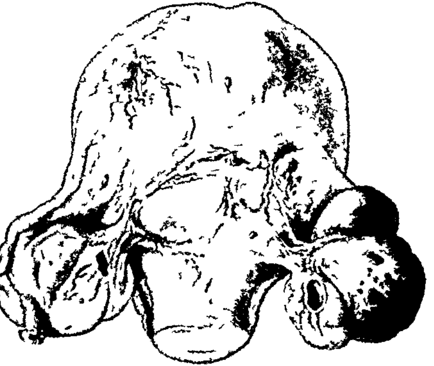


Fig 630—Endometriosis Multiple endometrial (chocolate) cysts of both ovaries with typical perforations Raspberry and blueberry implants upon the posterior surface of the uterus and ovaries Multiple adenomyomata and myomata Typical adenomyomatous adhesions *

which uterine endometriosis is produced Other explanations for this condition are embryonic rests celomic metaplasia and glandular dysfunction

Pathology—In generalized endometriosis, a multitude of brownish black puckered and pathlike areas are seen in the pelvic viscera ovaries pelvic floor uterosacral ligaments, pelvic peritoneum and sigmoid Each of these areas is composed of endometrial tissue containing old blood Cysts vary in size from a pinhead to an orange and, if present on the ovary may replace much of the organ (*chocolate cyst*)

The endometrial lining of a chocolate cyst undergoes a complete menstrual cycle the retained blood gradually distending the cyst until it finally ruptures Prior to rupture a large cyst usually consists of a single large cavity filled with thick chocolate-like material

* Curtis, Textbook of Gynecology

Hysterectomy—Hysterectomy may be complete or supra cervical A nulliparous woman with a normal cervix, is suitable for subtotal hysterectomy but a multipara with cervical erosions should have the more complete operation since carcinoma may develop in the cervical stump At operation the surgeon attempts to preserve enough ovarian tissue to prevent or minimize the symptoms of the *menopausal syndrome* (p 2525)

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50 mg The course may be repeated if menses and symptoms return provided that masculinization is not produced Conservative treatment failing our preference is for laparotomy and hysterectomy Roentgen castration does not establish the diagnosis or provide for freeing of adhesions and it may produce severe menopausal symptoms

SYMPTOMATIC TREATMENT OF DYSMENORRHEA

Dysmenorrhea may be controlled by psychotherapy the administration of hormones and drugs by surgery and by irradiation

DIFFERENTIAL DIAGNOSIS OF *Dysmenorrhea*

Dysmenorrhea is experienced at some time or another by the majority of women. In about ten per cent, it is sufficiently severe to produce incapacity and extreme discomfort It is customary to differentiate primary and secondary dysmenorrhea The former is observed in the absence of any noteworthy local lesion, while the secondary variety appears to be caused by organic pelvic disturbances

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	Usually in sensitive highstrung women
Mechanical	In linear habitus with generalized visceroptosis Acute anteflexion of uterus (p 2537)
Pharmacodynamic	From the use of ecbolics and oxytocics (p 2509) Drastic catharsis at menstrual time
Hormonal	Deficiency of progesterone Therapeutic response to extract (p 2527)
Gynecologic	Stricture stenosis polyposis or neoplasm of *the cervix (p 2551) Obtain biopsy if necessary* Advise reparative surgery Displacement polyposis fibroids and other neoplasms of the uterus (p 2554) Advise gynecography biopsy or curettage to be followed by laparotomy if indicated Endometriosis (p 2558) Inflammatory or neoplastic disease of ovary (p 2564) *Salpingitis stricture or stenosis of* tubes (p 2608) Pelvic peritonitis (p 2608) Advise laparotomy
Post partum	Subinvolution Retained secundines Uterine displacements (p 2537)

Psychotherapy—Dysmenorrhea is frequently observed in sensitive highstrung young women who have been taught to regard the menstrual period as the curse Under these circumstances the complaint dates back to the menarche and is often accompanied by menstrual molimina which the patient exploits to the limit Menstrual cramps prevent the child from going to school meeting obligations or performing chores The period is anticipated with anxiety and dread and it is followed by fatigue and exhaustion to the point where a physiologic process becomes a prime topic of conversation and a handicap of immeasurable proportion To combat this the old wives tales that are designed to frighten and embarrass little girls must be dissipated Children should be taught that menstruation is a

In some cases an endometrial cyst of the ovary may be difficult to distinguish from a hemorrhagic corpus luteum cyst

Rupture of endometrial cysts gives rise to additional endometrial implants and incites the formation of dense adhesions The uterus is often retroflexed and adherent to the pelvic floor

Clinical Manifestations—The principal clinical features of endometriosis are *menorrhagia* (p 2557) *sterility* (p 2492) and *dysmenorrhea* (p 2561) which becomes progressively more intense Some patients complain of increasing constipation and the clinical picture may suggest that of a carcinoma of the sigmoid (p 1888) The pain in ovarian endometriosis may be similar to that of ureteral colic being marked in the flank with radiation to the inner aspect of the thigh

On examination there are few characteristic findings External lesions such as vulval or umbilical cysts are rarely present Pelvic examination

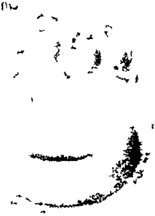


Fig 631—Vaginal endometriosis Patient in knee-chest position Nodules in a typical location posterior to cervix extending from an infiltrating growth in the rectovaginal septum Note puckering and fixation characteristic features

often reveals enlargement and fixation of the ovaries The uterus may be diffusely or irregularly enlarged retroflexed and fixed

Diagnosis—The diagnosis of endometriosis is difficult to establish The condition must be distinguished from chronic salpingitis uterine fibroids urinary lithiasis and carcinoma of the colon In many instances accurate diagnosis necessitates surgical exploration

Treatment—In older women endometriosis may be treated by *hysterectomy* or *roentgen castration* Younger women desirous of bearing children present a more difficult problem *Androgen therapy* may be attempted as a temporary expedient provided that the patient is willing to hazard the occurrence of masculinizing effects (p 2520) A total dose of 300 to 500 mg of testosterone propionate started no later than the sixth day of the cycle may produce amenorrhea for one to several months The preparation is given intramuscularly three times weekly in doses of 25 to

Patient of Dr Harold O Jones From Curt s Textbook of Gynecology

case of the postmenopausal period The peak of incidence is in the sixth decade

Pathology—Uterine cancer most frequently arises in the endometrium and spreads over the surface of the uterine cavity the invasion of the uterine wall occurring quite late The clinicopathologic types of tumor include adenoma malignum, adenocarcinoma and squamous cell cancer

Adenoma malignum arises from the malignant degeneration of a broad based or villous endometrial polyp It rarely invades the uterine wall and in many instances the histological criteria of malignancy are uncertain

Adenocarcinoma is the most common variety it is moderately invasive of the uterine wall and may penetrate to the serosal surface There is a certain amount of papillary formation which may block the internal cervical os leading to *pyometra* Tumor fragments at times are seeded through the fallopian tubes to ovaries tubal serosa and peritoneum direct extension to the cervix is fairly common but occurs late in the course of the disease Implants may be visualized on the vaginal wall Distant metastases are found in about 30 per cent of patients and commonly involve lungs and vertebrae; lymphatic metastases occur late into the pre-aortic and caval nodes Microscopic evidences of malignancy are readily apparent, the cells forming glandular acini or solid masses

Squamous cell carcinoma is comparatively infrequent, histological study discloses solid masses of cells resembling squamous epithelium There may be considerable glandular formation in some parts of the tumor giving rise to an *adeno-acanthoma*

In each of the histological types the uterus may appear but moderately enlarged and somewhat softened simulating an early pregnancy

Clinical Manifestations—The first and only symptom of consequence in cancer of the uterine body is *vaginal bleeding* in a woman past the menopause The bleeding may be a slight spotting or a profuse intermittent or continuous flooding It cannot be emphasized too strongly that uterine bleeding in a woman *past the menopause* should be regarded as presumptive evidence of cancer until proved otherwise Patients must be educated to realize the threat of postmenopausal bleeding (p 2527) and to report immediately for investigation

Examination usually reveals a smooth normal cervix the uterus may be normal in size but is more frequently enlarged and softened Myomas are present in about one third of the patients and should not be allowed to confuse the picture The practitioner does not rest content until diagnostic curettage has been performed despite meager physical findings Procrastination until the condition becomes obvious jeopardizes the possibility for effective treatment

Diagnosis—The diagnosis of uterine cancer is made by *biopsy* which is indicated in every instance of postmenopausal vaginal bleeding After dilatation of the cervix the first sweep of the curette may reveal friable chunks of tumor tissue in contrast to the translucent strips of normal endometrium The curette is used with caution since it is easy to perforate a uterus that contains a carcinoma and thus produce peritoneal spread of the neoplasm The curettings are examined by frozen section and if diagnostic of carcinoma a complete *hysterectomy* (p 2522) is immediately performed If there is any doubt as to the nature of the tissue a more complete pathological report is awaited before proceeding

Treatment—Cancer of the body of the uterus is treated by complete panhysterectomy bilateral salpingo ovariectomy and postoperative high voltage roentgen therapy of pelvis and lumbar regions In advanced inoperable lesions the patient is given radium therapy followed by intensive deep roentgen exposures Injections of androgen also may be instituted

normal process that the molimina are not detectable by male companions and that there is no appearance or odor that cannot be overcome by the aid of cleanliness together with the adjuvant assistance of toiletries and cosmetics (p 3138) The menstruating female should be encouraged to carry out normal activities shower or tub make dates go to dances engage in normal athletic activities and carry on with her work as in the intermenstrual period

Hormone Therapy—Progesterone (p 2517) may give relief in lesser disabilities reserving androgen (p 2520) for more severe distress especially that associated with menorrhagia and endometriosis

Pharmacotherapy—Symptomatic relief of dysmenorrhea is obtained with analgesics such as acetylsalicylic acid 0 3 gm (5 grains) every three or four hours with sedatives (sodium phenobarbital) 15 mg (¼ grain)



Fig 632—Adenocarcinoma of the uterus The tumor is a mere ragged thickening of the mucosa at the fundus There is a fibromyoma lodged in the substance of the uterine wall

every three or four hours with antispasmodics (syntropan N N R) 50 mg (¾ grain) three times daily or demerol N N R 50 mg (¾ grain) three times daily with opiate if necessary (codeine sulfate) 15 mg (¼ grain) every two hours for three or four dosages as indicated and with acidifying agents (ammonium chloride) 4 gm daily for two days preceding the onset of discomfort and for the first two days of the flow

Surgery—Diagnostic and therapeutic dilatation and curettage may relieve cervical dysmenorrhea reserving panhysterectomy for endometriosis (p 2588)

Roentgen Therapy—This form of therapy is employed particularly for endometriosis and fibroids at the time of the menopause

CARCINOMA OF THE UTERINE BODY

Carcinoma of the body of the uterus constitutes 15 to 20 per cent of uterine cancer In contrast to cervical malignancy it is essentially a dis

MacCallum Textbook of Pathology

DIFFERENTIAL DIAGNOSIS OF

Metrorrhagia

Metrorrhagia refers to vaginal bleeding that is independent of the menstrual cycle In this manner it is distinguished from menorrhagia which refers to prolonged or profuse menstrual bleeding (p 2557)

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	From maternal estrogen in the newborn (p 2778)
Trauma	*Injuries* particularly of impalement Instrumentation especially illegal abortion Look for evidences by vaginoscopy (p 3647)
Pharmacodynamic	From excessive or prolonged administration of estrogen (p 2515)
Hematologic	In blood dyscrasias characterized by systemic bleeding (p 1085) Check hemogram platelet count and bleeding and coagulation times (p 3696)
Hormonal	Metropathia hemorrhagica from hyperestrogenism or absence of formation of corpus luteum Exclude malignancy by biopsy or curettings if necessary Dysovulation with intermenstrual bleeding *Confirm by diagnostic curettage or biopsy if necessary*
Gynecologic	Pelvic inflammatory disease (p 2608) Uterine polyps fibroids or malignancy (p 2562) *Get diagnostic curettage* Malpositions of the uterus (p 2537) Endometriosis (p 2537) Confirm by laparotomy Inflammations cysts or neoplasms of cervix (p 2551) Suspect malignancy and get biopsy Granulosa or theca cell cysts of ovary or Brenner tumors (p 2570) *Confirm mass in fornix at laparotomy*
During Pregnancy	Threatened or inevitable abortion Placenta praevia (p 2661) Premature detachment of placenta (p 2665) *Rupture of vaginal varix* (p 2535) *Ectopic pregnancy* (p 2657) *Corroborate findings with consultant obstetrician*
Post abortal	Infection or retention of membranes (p 2652) Give anti infective agents (p 106) and consider dilatation and curettage
Post partum	Subinvolution of uterus responding to oxytocics (p 2715) Retention of membranes requiring curettage (p 2652) Hydatidiform mole or chorion epithelioma (p 2654) *Refer to obstetrician for confirmation of findings and biopsy*
Circulatory	Backward failure with other evidences of congestion (p 941) *Local vascularity* due to ascites or a large pelvic tumor Consider abdominal paracentesis (p 1920) and exploratory laparotomy

Despite intensive treatment by all modalities the prognosis is poor since complete excision of tumor tissue is rarely possible and the cells are fairly radioresistant

SARCOMA OF THE UTERUS

Sarcomas account for 2 to 5 per cent of uterine malignancies They arise from smooth muscle and connective tissue elements of uterus cervix and endometrial stroma Sarcoma of the body of the uterus usually initi ates in one of several myomatous tumors Grossly the tumor is soft and vascular resembling brain tissue Diffuse growths are usually submucous often with polypoid or sessile masses filling the uterine cavity The micro scopic picture is variable the cells are commonly of the spindle variety but small round cells and giant multinucleated cells are frequently seen Rare mixed tumors of mesodermal origin (*sarcoma botryoides*) contain cartilage

Clinical Manifestations—Clinically there are no characteristic symp toms or signs Sudden *enlargement* of a fibroid or persistent *pain* in the region of such a tumor suggests the possibility of sarcomatous degenera tion *uterine bleeding* is a common symptom and a foul *leukorrhea* is not unusual On *examination* the uterus is irregularly enlarged due to the presence of multiple fibroids occasionally a vascular polyp is seen protruding from the cervix Definite diagnosis is not possible until sar comatous tissue is obtained as a result of curettage or removal of a fibroid tumor containing a malignant area

Treatment—Uterine sarcoma is treated by complete hysterectomy and bilateral salpingo oophorectomy if possible The value of roentgen ther apy is questionable but high voltage irradiation is employed postopera tively as a measure of desperation Preoperative irradiation is open to the academic objection that it may cause sarcomatous degeneration in fibroids If an area of sarcoma is discovered on pathological examination of a uterus removed because of fibroids a second operation is usually not indicated

HYDATIDIFORM MOLE

See p 2654

CHORIONEPITHELIOMA

See p 2655

FOLLICULAR OVARIAN CYSTS

Follicular cysts of the ovary are small multiple collections of follicular fluid in unruptured atretic graafian follicles Cyst formation is favored by an inflammatory thickening of the ovarian capsule which prevents rup ture of the follicle Prolapsed edematous ovaries common in patients with uterine retrodisplacements frequently present numerous follicular cysts which project from their surfaces Usually they are less than 4 cm in diameter although a solitary cyst may attain the size of a lemon or small orange The cyst wall has a thin lining of follicular cells and the cavity is filled with clear watery fluid The latter at times contains sufficient estrogen to cause endometrial hyperplasia

luteum cells in response to stimulation by the gonadotropic factor produced by placental tumors They may attain the size of an orange are thin walled and contain a clear watery or slightly bloody fluid Removal of chorionic tissue is attended by prompt regression

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

GERMINAL INCLUSION CYSTS OF THE OVARY

Germinal inclusion cysts are invaginations of the germinal epithelium of the ovary and are lined by a single layer of these cells Their chief import lies in the fact that they may be the origin for *cystadenomas*

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

ENDOMETRIAL (CHOCOLATE) CYSTS OF THE OVARY

Endometrial cysts are small irregular cystic structures found *on the* surface of the ovary as features of *endometriosis* elsewhere described in greater detail (p 2508)

PSEUDOMUCINOUS CYSTADENOMA OF THE OVARY

Pseudomucinous cystadenoma constitutes 50 per cent of ovarian new growths The tumor is usually unilateral and multilocular and may attain astounding size filling the abdominal cavity and simulating an ascites (p 1921) The cyst is roughly ovoid with an irregular contour due to bulging of the loculi The remains of normal ovarian tissue may be appended to one pole On cross section cysts of varying size are disclosed Occasionally the cysts are so small that the tumor has a solid appearance The content of the cyst is a thick gelatinous secretion containing *pseudomucin* Microscopically the cyst wall consists of an outer connective tissue wall and an internal epithelial layer The epithelium is composed of a single layer of tall columnar cells with basal nuclei and clear cytoplasm The cells are reminiscent of goblet cells of the intestinal mucosa

Although the pseudomucinous cyst is usually benign rupture of the growth leads to the implantation of pseudomucinous epithelium throughout the peritoneal cavity and the development of *pseudomyxoma peritonaei* a condition marked by *recurrent pseudomucinous ascites* (p 1921) Pseudomucinous fluid contains large amounts of *hyaluronic acid* a complex polysaccharide This substance is rapidly split and the secretion is fluidified by *hyaluronidase* an enzyme

About 10 per cent of pseudomucinous cystadenomas become papillary marking the onset of a *malignant potentiality* The papillary growths may extend through the outer connective tissue capsule of the cyst and give rise to secondary peritoneal implants These may progress slowly or retrogress and disappear

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

SEROUS CYSTADENOMA OF THE OVARY

The serous cystadenoma is a thin walled multilocular ovarian tumor containing thin clear serous fluid As in the case of the pseudomucinous cyst the shape is irregular due to bulging loculi The cyst wall consists

Clinical Manifestations —As a rule, follicular cysts produce no clinical manifestations However, multiple follicular cysts may cause *lower abdominal pain* *menorrhagia* or *amenorrhea* *Torsion* of a cystic ovary is not *uncommon* and *rupture of a large cyst may occur* either event is attended by *acute abdominal pain* and evidence of *peritoneal irritation* On physical examination, only large follicular cysts are palpable The differentiation from a true ovarian neoplasm is impossible except when regression of the cystic swelling is actually observed on repeated examinations

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

CORPUS LUTEUM CYSTS

Corpus luteum cysts are collections of fluid at the site of the corpus luteum They are commonly solitary and rarely exceed 4 cm in diameter *They are believed to arise from hematomas of the corpus luteum during*

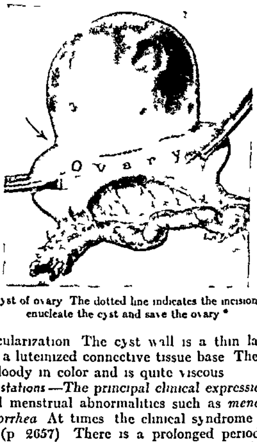


Fig 633 —Follicular cyst of ovary The dotted line indicates the incision which enables one to enucleate the cyst and save the ovary *

the stage of vascularization The cyst wall is a thin layer of granulosa luteum cells with a luteinized connective tissue base The cyst fluid varies from yellow to bloody in color and is quite viscous

Clinical Manifestations —The principal clinical expressions are lower abdominal pain and menstrual abnormalities such as *menorrhagia* *metrorrhagia* and *amenorrhea* At times the clinical syndrome simulates an *ectopic pregnancy* (p 2657) There is a prolonged period of amenorrhea followed by pain in a lower abdominal quadrant and profuse uterine bleeding On vaginal examination a tender unilateral mass is felt in the adnexal region Corpus luteum cysts are frequent in early pregnancy

Multiple *luteum cysts* of the ovaries are seen with *hydatidiform mole* (p 2654) and *chorionepithelioma* (p 2655) The cysts develop in unruptured follicles due to the excessive growth and activity of *theca* and *granulosa*

* Gyn Path No 33080 Courtesy of Dr Thomas S Cullen

luteum cells in response to stimulation by the gonadotropic factor produced by placental tumors They may attain the size of an orange are thin walled and contain a clear watery or slightly bloody fluid Removal of chorionic tissue is attended by prompt regression

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of an outer fibrous layer and an inner layer of low cuboidal epithelium Numerous glands composed of low cuboidal cells are prominent in the cyst wall Due to the tension of cyst contents the epithelium is often flattened and may be entirely absent In some instances a portion of a serous cystadenoma may be pseudomucinous

Papillary transformation in serous cystadenomas occurs more often than in the pseudomucinous variety The papillary tumor is irregular and nodular with a bluish white or brownish white color On section it appears honeycombed by cysts of different sizes whose walls vary in thickness from paper thinness to a centimeter or more in the region of nodules Papillary growths present raspberry like and cauliflower like nodules pro liferation is usually confined to the cyst cavity but may extend to the ex

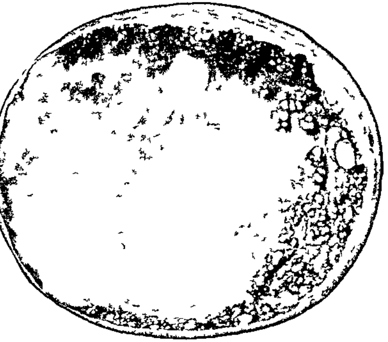


Fig 634 —A papillary cystadenoma of the ovary with papillary growths inside the cyst. If such a cyst is ruptured during removal or is aspirated this tissue may be tran planted to the peritoneum

terior forming nodular outgrowths Perforation and surface growth occur in 50 per cent of the tumors Implantations of the peritoneum are com mon as a result of capsule perforation

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

DERMOID CYSTS OF THE OVARY

Dermoid cysts constitute 10 per cent of all ovarian tumors but are *the most frequent ovarian neoplasms in children* They are often bilateral and may reach the size of a large grapefruit The cysts are round and have a smooth somewhat irregular surface The cyst wall is fairly thick and encloses a greasy semi solid sebaceous material which may contain

* Gyn Path No 35511 Courtesy of Dr Thomas S Cullen

hair bone and/or teeth The wall is lined by stratified squamous epithelium which is usually limited to the *mamilla* the small raised portion of the cyst wall This area may contain hair follicles sebaceous and sweat glands or cartilage The extramamillary portion of the wall in large cysts is devoid of epithelium The histogenesis of the dermoid an embryonic tumor is considered in the section on *Solid Teratomas* (p 2572) Not infrequently a dermoid is seen in combination with a large pseudomucinous cystadenoma

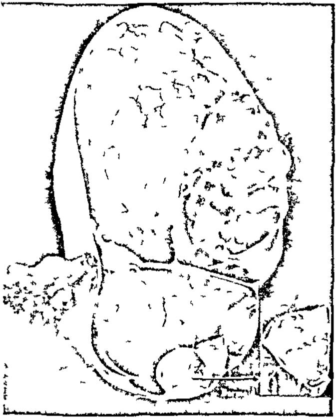


Fig 635—An ovary containing a pseudomucinous cyst and also a dermoid cyst The pseudomucinous cyst is clearly identified by the glairy thick mucoid material The dermoid was very small and occupies the lower part of the figure One sees the typical projection of solid tissue on which the characteristic structures grow In this case hair was growing from this area

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

FIBROMA OF THE OVARY

Ovarian fibromas constitute only 2 per cent of all ovarian tumors They are almost always seen in the adult They are typically bilateral and may be *diffuse* or *circumscribed* The diffuse types which may be spher

J H Gyn Path No 26 33 Martzloff Bull Johns Hopkins Hosp *33*

ical ovoid or kidney shaped are firm and attain large size On section the growth is white and smooth resembling a raw white potato Cavity formation hemorrhagic areas and calcified zones are common Microscopically, the tumor consists of typical fibrous tissue in which bundles of smooth muscle may be found

Meigs Syndrome —Ovarian fibromas are commonly associated with *ascites* and, at times *hydrothorax* the cause of which is not known (Meigs Syndrome) Similar findings have been reported in association with ovarian cysts and myomas of the uterus

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)



Fig 636—Bisected ovary containing a Brenner tumor *

BRENNER TUMOR OF THE OVARY

Brenner tumors are rare solid benign neoplasms seen in the postmenopausal period They are egg shaped with a smooth or nodular surface and are usually located near the hilus of the ovary well demarcated from the normal organ On section the growth has a firm fibrous consistency There are many cystic spaces with areas of calcification Microscopically the tumor consists of numerous follicle like clumps of epithelium (cell nests) in a dense fibrous stroma Some cell nests resemble graafian follicles while others simulate columns of squamous carcinoma cells The cell nests are believed to originate in embryonic rests Occasionally small Brenner tumors occur as nodules in the wall of large pseudomucinous cystadenomas They are also seen in combination with uterine myomas

* Courtesy of Dr Philip H Smith From Curtis Textbook of Gynecolo—

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

PRIMARY CYSTIC CARCINOMA OF THE OVARY

The cystic variety of ovarian carcinoma is the commonest primary ovarian malignancy The tumor is highly malignant and involves both ovaries in more than 50 per cent of the cases It usually arises from the malignant degeneration of a papillary serous cystadenoma (p 2567) Pseudomucinous cystadenomas are the sources of 10 per cent of the tumors and 2 per cent arise in dermoids Peritoneal implantations occur early and give rise to *hemorrhagic ascites* (p 1921)

PRIMARY CARCINOMA OF THE OVARY

Solid cancers of the ovary are relatively infrequent growths They appear as moderate sized egg shaped tumors with a rough papillary sur

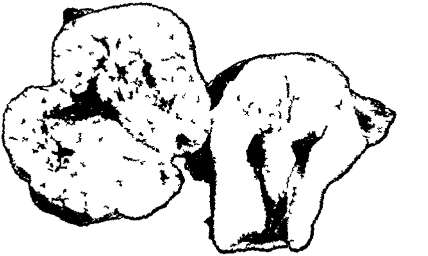


Fig 637 —Solid carcinoma of ovary secondary to carcinoma of the body of the uterus The ovary has been bisected

face but occasionally a solid carcinoma may fill the pelvis and most of the abdominal cavity On section the tumors have a soft moist brainlike consistency a yellowish white color and oftened hemorrhagic areas Some tumors however are hard and fibrous Histologically they vary and may resemble papillary and nonpapillary adenocarcinomas medullary carcinomas carcinoma simplex scirrhous carcinoma alveolar carcinoma or a plexiform carcinoma Local extension of the growth to the broad ligaments and pelvic peritoneum occurs early pulmonary metastases are common

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

SECONDARY OVARIAN CARCINOMA

The ovary is more frequently the site of metastatic carcinoma than of primary malignancy Both ovaries are invaded by growths which vary in

size from a lemon to a large grapefruit The implants are derived from endometrium stomach breast intestine gallbladder and rectum in order of frequency In typical cases metastases take the form of well defined tumor nodules separated by areas of normal ovarian tissue

The Krukenberg Tumor—The best known variety of secondary carcinoma although not the most frequent is the Krukenberg tumor This is a solid growth usually present in both ovaries The surface is smooth or lobulated On section there are cystic and gelatinous areas Microscopically characteristic large swollen *signet ring* cells are seen in a connective tissue stroma The tumor usually arises from a primary neoplasm of stomach or intestines

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

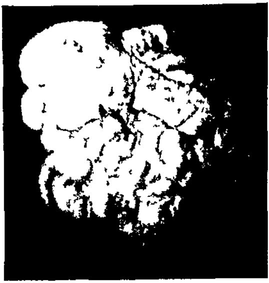


Fig 638—Disgerminoma of ovary size of grapefruit

SARCOMA OF THE OVARIES

Sarcoma of the ovary is a rare tumor of children and young adults It usually affects both ovaries The growth is moderately sized reddish in color and softer than a fibroma Histologically the tumor is composed of spindle shaped cells Local extension and distant metastases occur early before the tumor is apparent clinically

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

TERATOMA OF THE OVARY

Solid ovarian teratomas are composed of tissue derived from all three primary germ layers They are formed during the development of the embryo in the blastomere stage In reality a teratoma is a rudimentary or abortive twin The growth is a heterogeneous mass of embryonic tissues and organs The *struma ovarii of Pick* contains *thyroid* tissue which may appear normal or hyperplastic and has been reported to cause *hyperthy*

Courtesy of Dr Robert Greenblatt Curtis Textbook of Gynecology

rodism (p 1197) Malignancy is common with metastases to the perito neal cavity and distant organs Occasionally an ovarian teratoma gives rise to a *chorionepithelioma* and produces a positive *Aschheim Zondek test*

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

DYSGERMINOMA OF THE OVARY

The dysgerminoma is a rare malignant tumor that is usually seen in children and young adults with hypogenitalism or hermaphroditism The *growth is typically bilateral and moderate in size with a smooth or bossed* surface The cut surface is brainlike with hemorrhagic and necrotic areas *On microscopic examination it is found to be composed of columns* and alveoli of round cells with hyperchromatic nuclei The stroma is scant and there may *be lymphocytic infiltration The tumor is believed iden* tical with the *testicular seminoma* (p 2443) Although the growth is often malignant *with rapid growth and the early onset of metastases it may* be benign Removal has been followed by a normal pregnancy

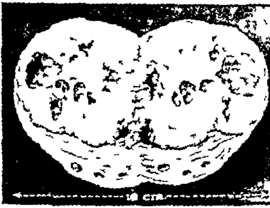


Fig 659—Granulosa cell tumor of ovary size of a peach The outside was irregularly nodular and *cystic The cut surface revealed a solid yellow gray tumor with cystic spaces, occupying* three-quarters of the enlarged ovary sharply demarcated from the ovarian tissue

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

GRANULOSA CELL TUMOR OF THE OVARY

Granulosa cell tumors are rare malignant growths composed of gran ulosa cells which elaborate *estrogen* and perhaps *progesterone* They oc cur at *all ages* but are *most common during the middle decades from* twenty to fifty and are more frequent in the prepuberal than in the post menopausal period The tumor varies in *size from* a small nodule to a large growth which fills the abdominal cavity It has a smooth often bossed surface and is purplish or reddish brown in color The cut surface is yellow or pink and reveals cystic areas Microscopic examination shows that the appearance of the cells varies widely Some cells arranged in alveolar or rosette forms resemble the lining of a graafian follicle Others

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Solid ovarian teratomas are composed of tissue derived from all three primary germ layers They are formed during the development of the embryo in the blastomere stage In reality a teratoma is a rudimentary or abortive twin The growth is a heterogeneous mass of embryonic *tissues* and organs The *struma ovarii of Pick* contains *thyroid* tissue which may appear normal or hyperplastic and has been reported to cause *hyperthy*

• Courtesy of Dr Robert Greenblatt Curtis, Textbook of Gynecology

tumor though it has never been seen in children and has a somewhat different histology

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

ARRHENOBLASTOMA OF THE OVARY

The arrhenoblastoma, one of the rarest ovarian neoplasms arises from primitive mesenchymal cells which would in the course of normal gonadal development give rise to *androgenic tissue* in the male gonad The tumor is usually small freely movable and of low grade malignancy Histologically the growth may be composed of small tubules (*adenoma ovarii testiculare*) or may be less differentiated (*anaplastic sarcomatous variety*) An undifferentiated tumor may be difficult to distinguish from a primitive granulosa cell tumor

The majority of arrhenoblastomas due to the production of androgen by the tumor cells gives rise to *virilism* (p 1268) In such instances the clitoris is enlarged scalp hair recedes and there is an increased growth of hair on the chest arms legs and face the breasts atrophy and the voice deepens amenorrhea may or may not be present The titer of follicle stimulating hormone in the urine of these patients is low and when coupled with hirsutism amenorrhea and an ovarian tumor indicates the diagnosis The amount of 17 ketosteroids in the urine a measure of adrenocortical function may or may not be increased The differential diagnosis from Cushing s disease (p 1159) and the adrenogenital syndrome is considered elsewhere (p 1268)

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

THE CLINICAL MANIFESTATIONS OF OVARIAN TUMORS

The ovarian tumor remains silent for long periods of time Most often it is revealed by routine vaginal examination Only rarely does it produce obvious symptoms until complications develop

With large cysts the patient may note abdominal swelling At times examination is requested because of menstrual irregularity uterine bleeding or changes in hormonal manifestations

Abdominal swelling is usually caused by huge pseudomucinous cysts but it may be due to the ascites which accompanies a fibroma or a carcinoma *Amenorrhea* is observed with follicular cysts luteum cysts and arrhenoblastomas *Menorrhagia* may be caused by follicular cysts luteum cysts or any of the malignant growths *Postmenopausal bleeding* results from the Brenner tumor granulosa and theca cell tumors and malignancies *Prepuberal bleeding* may indicate the presence of a granulosa cell tumor or a dermoid *Abdominal pain* in the absence of complications is rarely observed but may be present with follicular or luteum cysts

There are few clinical criteria for the recognition of the various types of ovarian tumors In many instances after a thorough investigation the presence of the tumor is the only positive finding The nature of the growth is a matter of conjecture until an exploratory laparotomy is performed Even then the surgeon and pathologist may be undecided as to the identity of the ovarian new growth after thorough study of a histologic section

are more like luteum cells, seen at the time of ovulation Parts of the tumor may look like a cellular sarcoma Metastases occur to the peritoneum and distant organs

The tumor elaborates large amounts of estrogen as indicated by high levels *in blood and urine In children, the tumor causes pubertas praecox* (p 2418) In postmenopausal women there is a return of uterine bleeding and the reappearance of estrogenic changes in uterine and vaginal mucosa (p 2184)

See *Diagnosis Complications and Treatment of Ovarian Tumors* (p 2576)

THECA CELL TUMORS OF THE OVARY

Theca cell tumors are an extremely rare group of unilateral tumors seen exclusively in women past the menopause They are associated with uterine bleeding and other evidences of estrogenic activity such as cystic

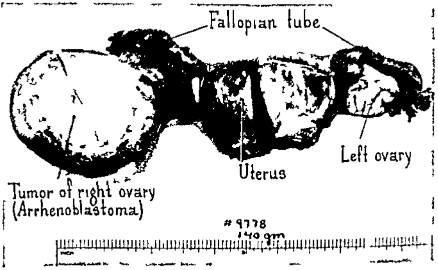


Fig 640 —An arrhenoblastoma removed from a forty two-year-old woman with marked virilism Following operation masculine features disappeared and former normal feminine traits reappeared (BUI 24473) *

hyperplasia of the endometrium and breasts The tumor differs from the granulosa cell neoplasm in being hard fibrous and yellow in color It closely resembles a fibroma Not uncommonly a dermoid or multilocular serous cyst is also present On section the surface is yellowish white and contains hyaline areas hemorrhagic zones small cysts and varying numbers of yellow nodules Histologically the yellow islands consist of plump spindle shaped cells containing lipoid and pigment granules These areas are surrounded by *fibrous tissue plaques and bundles of varying density* and structure The tumor is usually benign Malignant growths have been encountered however and are marked by ascites and metastases

The theca cell tumor is regarded as a variant of the granulosa cell

* Young Hugh H Genital Abnormalities Hermaphroditism and Related Adrenal Diseases Williams & Wilkins Co, Baltimore

Aschheim Zondek or Friedman test The latter may be misleading in the presence of a *granulosa cell tumor* or an *arrhenoblastoma*

A moderate sized or small tumor requires differentiation from a *sub serous uterine fibroid* a *tubal mass* a *parovarian tumor* an *intestinal new growth* an *ectopic viscus* and other types of *intrapelvic tumor* This is not always easy and requires painstaking examination and specialist con sultation

THE COMPLICATIONS OF OVARIAN TUMORS

In most instances the presence of the ovarian neoplasm not revealed *by routine vaginal examination is discovered only when complications* develop These include torsion rupture of a cyst suppuration and malig nant degeneration

Torsion of the Pedicle—Torsion of the vascular pedicle is the commonest complication of an ovarian neoplasm and usually occurs with small and *moderate sized* rather than large growths *The rotation is commonly in* a clockwise direction and includes varying numbers of complete turns After torsion has occurred it may untwist spontaneously only to repeat itself on some subsequent occasion The effects depend on the completeness of the ischemia induced by the torsion *Complete vascular occlusion* pro *duces gangrene* of tumor ovary *and its fallopian tube Infection of* the gangrenous mass is rapid and a *diffuse peritonitis* may develop unless the tissue is speedily resected Occasionally a tumor becomes detached from the pedicle and attaches to the omentum (parasitic) or undergoes com plete resorption Incomplete vascular occlusion produces intense venostasis *in ovarian cysts and thrombosis of the veins which may extend above the* ovarian pedicle

Torsion is commonly attended by acute lower abdominal pain nausea vomiting fever and leukocytosis The symptom complex is easily mistaken for *acute appendicitis* In some instances the pain is dull shortlived and recurrent due *to repeated torsion and untwisting*

Rupture of a Cyst—Rupture of a large ovarian cyst is a common event as a result of trauma or in the absence of any known precipitating factor It may occur in the course of a bimanual examination Rupture of a large pseudomucinous or serous cystadenoma is attended by acute abdominal pain prostration and shock There may be a severe intraperitoneal hemor rhage If the cyst is infected or if its contents are irritating a fulminating diffuse peritonitis follows Rupture of serous or pseudomucinous cysts leads to seeding of the peritoneal cavity with neoplastic tissue

Suppuration—Ovarian neoplasms especially dermoids are easily in fected for reasons difficult to explain The infection may be due to con tiguous or hematogenous bacterial dissemination The clinical picture is that of an acute intraperitoneal infection and is marked by chills fever and *abdominal rigidity*

Malignant Degeneration—Malignant degeneration occurs in large cys tadenomas and dermoids Its presence is suggested by rapid growth of the tumor and development of ascites The experimentally proven carcinogenic action of estrogens causes the practitioner to hesitate before administering hormone to the patient with an ovarian tumor Estrogenic *therapy should* never be given before making a vaginal examination

In a few instances it is possible to hazard a guess as to the nature of the mass but the practitioner ever fearful of the presence of malignancy or of the onset of malignant degeneration prefers to see the slides first and discuss diagnosis after the tumor has been removed

For guidance in differential diagnosis the undernoted clinical axioms relative to ovarian tumors may be helpful

1 Bilateral swellings during the period of active menstruation which disappear in a few weeks are probably *follicular cysts* (p 2564)
2 A moderate size tumor appearing in early pregnancy and disappearing after a few weeks is a *corpus luteum cyst* (p 2566)
3 Large tumors are usually *pseudomucinous cysts* (p 2567)
4 Smaller bilateral tumors particularly in children are usually *dermoids* (p 2568)
5 If radiographs of the abdomen are taken and the tumor seems to contain calcific material or a tooth it is probably a *dermoid*
6 A small movable ovarian growth associated with ascites and hydrothorax may be a *fibroma* (Meigs Syndrome)
7 A small tumor in a child associated with precocious puberty is likely a *granulosa cell neoplasm* (p 2573)
8 A small tumor in the postmenopausal period associated with a return of menstruation and evidences of sexual rejuvenation is probably a *granulosa cell neoplasm* (p 2573)
9 An ovarian tumor associated with amenorrhea and virilism is an *arrhenoblastoma* (p 2575)
10 An ovarian tumor associated with hemorrhagic ascites is probably a *cystic carcinoma* (p 2571)
11 An ovarian tumor associated with hyperthyroidism and/or a positive pregnancy test may be a *teratoma* (p 2572)
12 A bilateral ovarian swelling associated with digestive symptoms is probably a *Krukenberg tumor* (p 2572)
13 The most frequent ovarian tumors in children are *dermoids* and *dysgerminomas* (p 2573)

DIAGNOSIS OF OVARIAN TUMORS

Ovarian tumors must be differentiated from other conditions which may give similar physical signs such as ascites pregnancy and uterine or tubular masses

Large cysts are not easy to distinguish from *ascites* (p 1921) The presence of a cyst may be determined by the percussion findings of superficial dullness absence of shifting dullness and resonance in the flanks However these signs are not easy to elicit in an obese woman with a large flaccid cyst Not uncommonly a large cyst and ascites are present simultaneously as in the serous and pseudomucinous cystadenomas and the cystic ovarian carcinomas When in doubt a diagnostic abdominal puncture is performed and the material subjected to histological study

A large cystic or solid tumor may simulate a *normal pregnancy* particularly if there is an associated amenorrhea (p 2618) As a rule a correct diagnosis is made by differentiating the mass from the uterus by demonstrating the fetal skeleton on a radiograph and by the performance of the

Cysts and Neoplasms	Congenital cyst (unilateral with occasional discharge of witch s milk) (p 2778) Chronic cystic mastitis (multiple cysts with evidence of inflammation) (p 2580) Galactocele (during lactation) Blue dome cysts (solitary lesions appearing just before or just after menopause) Benign fibromas and lipomas (p 2579) Intracanalicular fibromas (p 2581) Carcinoma and sarcoma of brea t (p 2581) Biopsy
	Sebaceous adenoma of nipple (p 3148) Epithelioma of nipple (p 3208) Paget s disease of the nipple (p 2581) Biopsy

TREATMENT OF OVARIAN TUMORS

In every instance of established or suspected ovarian tumor the *abdomen is explored* to establish the diagnosis and remove the mass Every ovarian tumor is potentially malignant and should be removed unless there are sound reasons for doing otherwise (Wharton) Before closing the abdomen it is wise to have an accurate *histological diagnosis* by frozen section so that the surgeon may be guided in his examination of the contralateral ovary and of the pelvic viscera for metastases Prior to removal a very large cyst may be emptied by aspiration

Even in the presence of metastases to the peritoneum removal of the primary ovarian tumor followed by deep roentgen therapy may produce a favorable result *Roentgen therapy* alone is indicated in inoperable malignant lesions but the results are generally poor

BENIGN TUMORS OF THE NIPPLE

Benign tumors of the female nipples are frequently seen and are of little clinical importance The areola is frequently the site of a very small *adenoma* a *sebaceous cyst* or a *lipoma* So long as the neoplasm is small and shows no tendency to ulcerate or infiltrate removal is neither advisable nor necessary

BENIGN TUMORS OF THE BREAST

Benign tumors of the female mammary glands are often encountered For the most part they are encapsulated an important feature in differentiating them from malignancy However the pericanalicular fibromas and *benign papillary growths of the ducts are not encapsulated and often* give rise to difficulties in clinical diagnosis

Encapsulated Benign Tumors—Encapsulated benign tumors of the breast include *fibromas fibroadenomas cystadenomas* and *lipomas* This group constitutes *the most frequent tumors that occur in the breasts of young* women They are often *multiple* and *bilateral*

The benign encapsulated tumor of the mammary gland is usually noted by the woman when she dries herself after bathing The mass is clearly defined and mobile The adjacent mammary tissue *is not retracted and* observation fails to reveal evidences of growth

Despite clearcut features attesting to the probably benign character of

DIFFERENTIAL DIAGNOSIS OF

Clinical Disturbances of Breasts and Nipples

The female breast may suffer physiologic disturbances particularly referable to lactation in pregnancy The more common organic difficulties include acute infections usually the result of suckling and neoplastic involvements The most serious of the latter is the malignant growth whose presence must be suspected in the presence of any palpable induration or in association with serosanguineous discharge from the nipple

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	Premenstrual and menstrual congestion and engorgement (p 2489) Colostrum secretion and lactation during pregnancy and the puerperium (p 2623) Atrophy after menopause Hypertrophy during pregnancy and lactation
Pharmacodynamic	Hypertrophy with estrogen (p 2515) Lactation from lactogenic anterior pituitary hormone (p 1154) Agalactea following pregnancy after estrogen or androgen (p 2401) Malignant transformation from prolonged use of estrogen (p 2515)
Secretory Disturbances	Witch s milk from congenital cysts in the non pregnant (p 2778) Lactation of the new born Agalactea polygalactea and caked breasts in pregnancy (p 2623)
Gynecomastia	Hypertrophy of male breast with lactation in hypopituitarism and dyspituitarism (Fröhlich s syndrome) (p 1166)
Tegumentary Disturbances	Pigmentation (pregnancy lactation, adrenal cortical deficiency hyperpituitarism and hyperthyroidism) (p 1197) Lymphedema (peau d orange) with advanced malignancy (p 2581) Retraction of nipples with malignancy Get biopsy
Neurogenic Disturbances	Mastodynia or mastalgia from trauma (p 2546) Engorgement of pendulous breasts Irritation of ill fitting brassieres Premenstrual tension Pregnancy Lactation Caking of breasts Mastitis (p 2612) Also in neuroses and hysteria
Congenital Anomalies	Asymmetry Accessory breasts or nipples in axilla or along mammary ridge between mid clavicular region and inguinal fossa (p 2533) Inversion of nipple (p 2533)
Mechanical Disturbances and Trauma	Pendulous breasts Acute ecchymosis or hematoma with traumatic fat necrosis (p 2546) Chronic irritation from pressure of ill fitting brassiere Cracks and fissures of nipples (p 2623)
Inflammations and Infections	Acute mastitis (p 2612) Chronic mastitis (p 2613) Chancre of nipple (p 2613) Tuberculous mastitis (p 2613) Check darkfield for spirochetes (p 45) and biopsy for tuberculosis.

CONTINUED

probably will Following operation even if the sections are clearly benign in character repeated examinations are urged and injections of *estrogen* are avoided lest there appear a carcinogenic effect (p 2517)

PAGET S DISEASE OF THE NIPPLE

Paget s disease of the nipple represents two different and disconnected pathologic processes occurring simultaneously in the mammary tissue and its overlying integument In all likelihood the disturbance commences as a superficial *carcinoma of a duct* of the breast which disturbs the *lym phatics* about the nipple and areola producing neoplastic changes in the integument

Whereas histologists debate the pathogenesis and cellular features of this curious disease the clinical diagnosis is readily suspected if the con dition is borne in mind An ulcerating granular weeping and itching area develops around one nipple and its areola The skin surface is covered by



Fig 642—Carcinoma of the breast showing retraction of the nipple and limited invasion of the fat

a dry scaly material which has a tendency to break down become moist and bleed easily In characteristic examples a tumor is felt deeper down in the breast tissue but even if this is not demonstrable a biopsy is taken to seek typical *Paget s cells* These are found in the malpighian layer and are large and hyperchromatic with a decided malignant appearance Ad ditionally the underlying duct neoplasm reveals the characteristic appear ance of a superficial *carcinoma*

Radical amputation of the breast is required with removal of the axil lary structures The growth is of low grade malignancy The prognosis is highly favorable if early excision is practiced and a thorough dissection accomplished

CARCINOMA OF THE BREAST

Cancer of the female breast occurs with tragic frequency Its presence should be suspected any time that a lump is observed *in the mammary* tissue

MacCallum Textbook of Pathology

the growth the neoplasm should be removed for histological study If several are present the largest is chosen for excision

Non encapsulated Benign Tumors —Non encapsulated benign tumors of the breast include *pericanalicular fibromas* and *benign papillomas of the ducts* These unusual neoplasms are noted after the age of thirty They grow slowly and produce *bleeding from the nipple* or a *serous yellow discharge*

The resemblance of the clinical characteristics of benign non encapsulated tumors to those of malignancy requires that *histological study* be made and the *mass excised* if it is at all possible *Roentgen therapy* is of no value

CHRONIC CYSTIC MASTITIS

Chronic cystic mastitis has the combined features of chronic inflammation and neoplasm It is not at all unlikely that future study will re

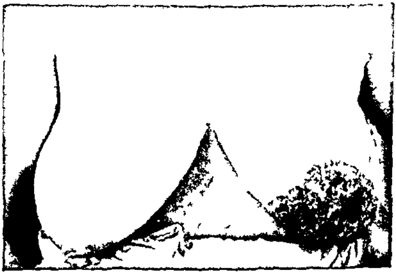


Fig 641 —Showing Paget s disease of the nipple that began as a granular ulceration of the nipple slowly extending onto the areola and out over the skin At times the area is covered by a dry scaly hard integument sharply defined at other times the entire area is moist, has a mucoid secretion and bleeds easily

veal that the condition like benign hypertrophy of the prostate and uterine fibromas bears some relationship to hormonal imbalance

Chronic cystic mastitis is usually associated with subjective complaints such as a sticking *pain* referred to the shoulder or the inner side of the upper arm The distress increases at the menstrual time and the breasts simultaneously become tender Palpation reveals considerable sensitivity If the mammary tissue is pinched up a lump is felt but examination with the flat of the hand fails to confirm this finding The breast however has a generalized shotty feel This sensation is also noted in the opposite gland

The ease with which the tumor may be excised for histological examination makes an academic discipline of preoperative differential diagnosis In point of fact if the practitioner does not insist upon biopsy the patient

* Adair in Christopher Textbook of Surgery

With metastatic deposits symptomatic efforts are initiated Pain is relieved by *analgesics* (p 3832) but later it is necessary to resort to *opiates* The addition of *hyoscine* is immensely gratifying provided that the patient does not develop untoward reactions to the drug (p 387) Our own preference is for the combination of *dilaudid* 2 mg (1/30 grain) and *hyoscine hydrobromide* 0.3 mg (1/200 grain) It may be possible to substitute *demerol* in 50 to 100 mg dosages in place of the dilaudid *Injections of androgen* or *transplants of testicular substance* may check the advancing carcinomatous growth *Roentgen castration* of the ovaries is recommended if the mastectomy was not accompanied by oophorectomy

With localized root pains *nerve block* may be attempted by alcohol injection or severance of the posterior roots

SARCOMA OF THE BREAST

Sarcoma of the breast is a rare malignant tumor It arises from the periductal connective tissue and may originate in a preexisting fibro adenoma a neurofibroma an intracanalicular fibro adenoma or in the lymphoid tissue of the breast

The condition is clinically recognized through the rapid growth of a pre existing tumor Untreated it tends to break down and metastasize to the chest wall *Treatment* follows the principles outlined for mammary cancer (p 2582)

Pathology—The cellular appearance of cancers of the female breast varies considerably Glandular features are prominent in *adenocarcinomas* while fibrous elements predominate in the *scirrhus* Many attempts have been made to estimate the *grade of malignancy* by histologic section but undoubtedly the prognosis of these tumors is dependent more upon the rapidity and thoroughness with which therapy is initiated *Metastases* occur through the lymph channels and hematogenously the axillary anterior mediastinal and internal mammary nodes are most frequently involved blood stream deposits become manifest most often in bones breast and brain

Clinical Manifestations—The earliest clinical manifestations of cancer of the breast is the discovery of the *lump* Ordinarily this is not found unless it is sought The practitioner must make it part of his routine examination to palpate the breasts with the greatest thoroughness He can perform no more important function in cancer control

Many surgeons urge that women be instructed to palpate the breasts at frequent intervals and to report to the physician immediately if any abnormality is noted This practice has advantages and disadvantages Once in a great while a very early diagnosis of cancer of the breast is established and surgery is accomplished at a time when there is optimum chance for cure Against this a very large number of women develop cancer phobia and suffer prolonged periods of profound anxiety Perhaps in this as in other debatable circumstances the practitioner must individualize his approach to the problem Certain women of intelligence with reasonable emotional stability may be instructed to conduct self examination Others beset with intense anxieties and fears and with disturbing psycho emotional instability cannot be enlisted in this campaign

At the time that the breast cancer is most amenable to surgical cure the lump is the only manifestation of the malignancy By the time pathognomonic phenomena are observed considerable valuable time has been sacrificed The tumor is then felt to be *adherent* to the skin or the underlying structures retraction is manifested by *dimpling* when the woman elevates her arms bends over changes position or manipulates her breast the diameter of the breast shortens asymmetry and narrowing of the areola are observed the *nipple* becomes distorted and is deviated depressed or retracted fine *infiltrations* are felt in adjacent vascular channels the overlying skin develops a curious type of edema that has been described as *orange skin* or *pig skin* enlargement is noted in the *axillary glands* Radiographs of the chest may reveal fine infiltrations *skeletal pains* foreshadow visible radiographic evidence of metastatic deposits

The final stage is accompanied by the development of *general cachexia* or *severe anemia* Those with osseous implants suffer intractable pain The clinical picture may be dominated by pulmonary cerebral or axillary deposits

Treatment—The treatment of cancer of the female breast involves early diagnosis radical surgery and roentgen therapy

Early diagnosis is accomplished by regarding each mammary infiltration or tumor as a potential malignancy Without regard to clinical axioms the tissue is removed and inspected When the criteria of malignancy are established a *radical mastectomy* is performed, with careful axillary dissection *Bilateral oophorectomy* is advised at the same time *Postoperative roentgen therapy* is practised whether or not the statistical evidence finds justification for this type of adjuvant therapy

is indicated by the bacteriologic findings or administered in probatory manner

DIFFERENTIAL DIAGNOSIS OF

Vaginal Discharge (Leukorrhea)

Vaginal discharge or leukorrhea is an exceedingly common complaint which may arise from a variety of irritations involving external and internal genitalia In most instances the practitioner has no difficulty in identifying the source of the discharge by direct examination.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	At ovulation time (p 2487) Just before and just after menstruation (p 2483) Lochia rubra and alba postpartum (p 2715)
Congestive	Backward failure (p 941) With local congestion due to large tumors ascites or late pregnancy
Vulval	Irritation due to tight clothing soiled diapers incontinence of urine or fecal contamination Lacerations and fissures (p 2536) Nonspecific gonorrheal and mycotic vulvitis (p 2593) Skeneitis and bartholinitis (p 2586) Obtain specimens for microscopy (p 50)
Vaginal	Nonspecific gonorrheal or tuberculous vaginitis (p 2588) Trichomonas mycotic and monilial vaginitis (p 2598) Impacted foreign body Chemical vaginitis due to topical and local applications Examine discharge microscopically and culture
Cervical	Erosion ectropion laceration, prolapse elongation or hypertrophy of cervix (p 2534) Cervical polyps cysts fibroids or malignancy (p 2551) Cervicitis and endocervicitis (p 2600) Chancre of cervix (p 2602) Obtain specimens through vaginoscope for microscopy culture and biopsy
Uterine	Uterine malpositions (p 2537) Endometritis (p 2602) Polyps fibroids and malignancy of uterus (p 2562) Hydatidiform moles and chorionepitheliomas (p 2655) Subinvolution Retention of membranes (p 2652) Necrosis of subendometrial fibroid or polyp (p 2554) Postabortal and puerperal endometritis (p 2602) Do curettage
Urethral	Acute and chronic urethritis (p 2338) Get specimens for smears and cultures (p 2339) Urethrocele and incontinence of urine
Tubal and Ovarian	Salpingo-oophoritis of nonspecific gonorrheal or tuberculous origin (p 2610) Consider laparotomy
Peritoneal	Acute and chronic pelvic peritonitis (p 2604) Consider laparotomy

For the treatment of ambulatory patients sulfadiazine is the preparation of choice and 2 to 4 gm (30 to 60 grains) are given as an initial

CHAPTER 122

THE FEMALE REPRODUCTIVE SYSTEM: INFECTIONS AND NONBACTERIAL INFLAMMATIONS

INFECTIONS of the female reproductive organs constitute common problems in general practice due chiefly to the frequency of venereal diseases and the high incidence of postabortal and puerperal disturbances Invasions occur by local implants by continuity and through hematogenous and lymphogenous routes The consequences may be purely topical or the local lesion may act as a portal of entry for serious systemic complications in the near or remote future

ANTIBIOTIC THERAPY

The organisms which cause the venereal diseases and the streptococci which usually produce endometritis pelvic peritonitis puerperal and post abortal sepsis are sensitive to antibiotic therapy In consequence infectious diseases of the female reproductive organs furnish a rich and fertile field for sulfonamide, penicillin or streptomycin therapy whether treatment

adult female as in the male the initial manifestations of the disease are ordinarily in the urethra Hence the descriptions are included in the Section on the *Urinary System* (p 2338)

The infection may spread and involve genital tract tubes ovaries and pelvic peritoneum The invasion is by direct extension along the surface epithelium and to a lesser extent by way of lymphatics and blood vessels The initial infection is superficial and limited to epithelial and subepithelial tissues Later muscular and serous tissues are affected with the production of marked deformity As a result of the scarring gonorrhea is a common cause for *sterility* since it leads to stenosis of the cervix obstruction of the fallopian tubes and thickening of para ovarian tissues (peri oophoritis) In some instances the ovaries are involved and extensively destroyed by tubo ovarian abscesses

Clinical Manifestations —In the adult female the clinical manifestations of gonorrhea usually are those of the *urethritis* (p 2338) In infants and young children however the disease manifests itself as a *vulvovaginitis*

Gonorrheal Vulvovaginitis —Acute gonorrheal vulvovaginitis is essentially a disease of prepuberal girls In contrast to gonorrhea in the adult female there is little tendency for the infection to localize in the urethra the rudimentary Skene s ducts or the Bartholin glands The upper genital tract is rarely involved and spontaneous cure is common

Gonorrheal vaginitis is a fairly frequent infection in institutionalized children It is spread rapidly by nonsexual contact and often in spite of elaborate precautions The usual sources of infection are contaminated toilet seats linen enema tips rectal thermometers or fingers less often it is disseminated by sexual contact The susceptibility of the child s vagina apparently resides in its lining of cuboidal epithelium which has little resistance to gonococcal invasion The adult vagina on the other hand has a lining of resistant squamous epithelium Neonatal infection is rare since the maternal estrogens convert the infantile vaginal lining into a squamous type

The clinical picture is that of an acute vulvovaginitis with a profuse *purulent discharge* (p 2585) The external genitalia appear reddened and edematous The vaginal walls are often glued together by seropurulent exudate The general health is not affected as a rule

Gonorrheal Vulvitis —Involvement of the vulva in gonorrheal infection is always secondary and requires no treatment other than that directed at the earlier lesion

Chronic Gonorrhea —Chronic gonorrheal disease involves only the glands of Bartholin in the lower genital tract chronic *bartholinitis* results from occlusion of the duct and retention of purulent products The retention abscess or cyst is recognized as a tender swelling in the labia

Diagnosis.—The diagnosis of gonorrheal lesions of the lower genital tract requires laboratory confirmation through the examination of *smears* and *cultures* Material is collected on two sterile cotton swabs inserted at the same time one swab is used for the smear the other is moistened with a few drops of sterile nutrient broth and cultured on McLeod s chocolate agar After inoculation the plates are incubated at 35° C in an atmosphere of 10 per cent carbon dioxide The plates are examined at twenty four hour intervals for three days The *oxidase test* is used to detect sus

dose depending on the severity of the infection and the age of the patient Thereafter 0.5 to 1 gm (7½ to 15 grains) is given at three or four hour intervals Each dose is accompanied by ½ to 1 teaspoonful of bicarbonate of soda or an alkaline charged water

A minimum of 2500 cc of fluid should be taken Toxic manifestations are sought and arrangements made for the patient to report daily bringing a urine specimen and submitting to a blood count at the end of 24 to 48 hours and every few days thereafter In the ambulatory patient penicillin is reserved for treatment failures and for instances such as gonorrheal infection in which speed of cure is mandatory It is our practice to give intramuscular injections at 8 and 11 A M 2 5 8 and 11 P M The initial dose is 40 000 units and subsequent doses of 20 000 to 40 000 units are administered thereafter If penicillin in oil wax is used, deposits of 300 000 units may be injected at twelve or twenty four hour intervals

The patient who is confined to bed or hospitalized may have either or both drugs if an attendant is equipped to give the penicillin injections Our preference is for penicillin because of its lack of toxicity and generally superior therapeutic efficacy Those who are more than moderately *ill* are best treated by the parenteral administration of both remedies Sodium sulfadiazine as 100 cc of a 5 per cent solution may be injected intravenously while penicillin is best given intramuscularly at the same time or an hour or two later

For topical use 5 per cent *sulfathiazole suspension* and sulfanilamide powder are available but our experience with these is not wholly satisfactory and we favor systemic treatment if it is to be given at all On the *other hand solutions of penicillin (1 cc = 250 to 500 units)* are easily prepared and give great promise of amazing benefit The efficacy of the antibiotics is such that time honored remedies such as silver and anti streptococcal serums appear feeble and futile modalities

ACUTE NONSPECIFIC VULVITIS

Acute nonspecific vulvitis is a common accompaniment of irritating vaginal discharges chafing masturbation uncleanliness and trauma It also occurs in the course of diabetes mellitus typhoid fever scarlet fever and agranulocytosis

The condition is characterized by local redness tenderness ulceration discomfort and exudation The diagnosis is not established until specific venereal infections are eliminated by the various diagnostic tests

Treatment consists of removal of the irritating factor and thorough cleansing of the parts followed by the application of a simple dusting powder 5 per cent sulfathiazole suspension or a solution or suppository of penicillin

GONORRHEAL VULVOVAGINITIS

The female reproductive system is *structurally an excellent* habitat for the gonococcus The organisms easily gain entrance through the short urethra into Skene s ducts Bartholin s glands and endocervix In children vulva and vagina are peculiarly susceptible and infection in *schools* and institutions may spread rapidly and assume epidemic proportions In the

ulcer formation with a necrotic base and an abundant purulent *vaginal discharge* (p 2585) About *one third of the women have an inguinal adenitis* on one or both sides These *buboes* frequently go on to suppuration

The prime diagnostic consideration is the exclusion of syphilis (p 331) Repeated darkfield examinations are required since the primary lesion of lues is often atypical and the two venereal diseases may coexist in a single individual *Positive evidence of the chancroidal infection is made* by demonstration of the *H ducreyi* by stain and culture A skin test is also available but even if all of these diagnostic criteria are present there is still the possibility that there is in addition a spirochetal invasion

The more complete discussion of chancroid and its treatment are elsewhere detailed (p 288) *It is sufficient to state* here that the *sulfonamides* (p 88) have tremendous prophylactic and curative efficacy Inguinal buboes are treated by compresses until resolution or suppuration occurs In the latter instance they are incised drained and packed with gauze containing sulfathiazole powder The presence of an intercurrent syphilis should not *interfere* with the treatment of the chancroid



Fig 643—Chancroidal bubo

SYPHILIS OF THE VULVA

Genital syphilis is rarely observed in the female From the epidemiological standpoint the overlooked genital syphilid provides a reservoir of infection From the individual viewpoint the relatively minor local discomfort of the lesions explains the appreciable incidence of *syphilis d emblee in which the generalized manifestations are observed without a semblance* of a primary sore These considerations emphasize the importance of regarding each genital lesion as potentially syphilitic unless darkfield microscopy and serological tests eliminate that possibility

The Primary Chancre—The primary lesion of syphilis is most often seen on the *cervix* (44 per cent) and next on the *labia majora* (31 per cent) Other possible locations include the *labia minora fourchette urethra* and *clitoris* (2 7 *to* 8 *per cent*) *Least frequently the initial lesion* occurs in *vagina vestibule perineum mons veneris* and adjacent structures (0 1 to 1 4 per cent)

picious colonies which are then examined microscopically The organism is finally differentiated by *carbohydrate fermentations* (p 220)

Treatment —The modern therapy of gonorrheal vulvovaginitis utilizes *sulfadiazine* or *sulfathiazole* (p 2452) in doses which vary with the age and weight of the patient In general relatively larger doses are needed for longer periods than in adults as indicated by Table 143

Penicillin produces results that are superior to those effected by sulfonamide It is beneficial in sulfonamide resistant infections has no toxicity and the cure" is accomplished within a few hours by five or six intra muscular injections totaling 100 000 to 180 000 units

A useful adjunct to anti infective therapy is the insertion of vaginal suppositories of natural *estrogen* (p 2510) or the oral administration of *stilbestrol* (p 2515) both of which change the vaginal mucosa into the adult squamous type producing a condition unfavorable to the growth of the organism The usual dose of stilbestrol is 0 1 mg three times daily for two to three weeks

Following subsidence of the acute process the patient is observed for a period of six months before being discharged as cured Chronic bartholin

TABLE 143 —SULFATHIAZOLE DOSAGE IN GONOCOCCAL INFECTION IN AMBULATORY CHILDREN

Age	Weight (lbs)	Total Daily Dose (grams)	Doses per Day	Total Days
1–2	20–27	0 75	4	10
2–5	27–42	1.5	4	10
5–9	42–62	2 0	4	10
9–11	62–100	2.5	4	10

cysts at this time should be excised Abscesses are incised and drained as soon as suppuration is noted

TUBERCULOUS VULVITIS

Vulval tuberculosis is rare and occurs secondary to tuberculosis of the fallopian tubes The typical lesion is an ulcerative serpiginous grayish in dolent eruption which infiltrates the surrounding tissue and heals with scarring and fistula formation

The diagnosis is made with certainty only when the biopsy reveals characteristic tubercle caseation and the presence of acid fast bacilli The lesions may be subjected to anti infective therapy with sulfonamide and/or penicillin in order to eliminate secondary invaders

CHANCROID OF THE VULVA

Infections of the female with *H ducreyi* produce the papulopustular lesion of chancroid The *soft chancre* usually appears about three days after exposure through sexual intercourse and is located most often at the vaginal introitus The inflammatory disturbance soon shows evidence of

ulcer formation with a necrotic base and an abundant purulent *vaginal discharge* (p 2585) About one third of the women have an *inguinal adenitis* on one or both sides These *buboes* frequently go on to suppuration

The prime diagnostic consideration is the exclusion of syphilis (p 331) Repeated darkfield examinations are required since the primary lesion of lues is often atypical and the two venereal diseases may coexist in a single individual Positive evidence of the chancroidal infection is made by demonstration of the *H ducreyi* by stain and culture A skin test is also available but *even if all of these diagnostic criteria are present* there is still the possibility that there is in addition a spirochetal invasion

The more complete discussion of chancroid and its treatment are elsewhere detailed (p 288) It is sufficient to state here that the *sulfonamides* (p 88) have tremendous prophylactic and curative efficacy Inguinal buboes are treated by compresses until resolution or suppuration occurs In the latter instance they are incised drained and packed with gauze containing sulfathiazole powder *The presence of an intercurrent syphilis* should not interfere with the treatment of the chancroid



Fig 648 —Chancroidal bubo

SYPHILIS OF THE VULVA

Genital syphilis is rarely observed *in the female* From the epidemiological standpoint the overlooked genital syphilid provides a reservoir of infection From the individual viewpoint the relatively minor local discomfort of the lesions explains the appreciable incidence of *syphilis d emblee* in which the generalized manifestations are observed without a semblance of a primary sore These considerations emphasize the importance of regarding each genital lesion as potentially syphilitic unless darkfield microscopy and serological tests eliminate that possibility

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The characteristic chancre of the vulva appears as a nodule erosion or induration and is seen three to four weeks after exposure The edges are slightly raised above the center, which is depressed and reddened Often there is enlargement of the *inguinal nodes*

The astute practitioner will not rely upon the physical characteristics of the lesion since it is quite possible for syphilis to be inoculated through



Fig 644 —Chancre of the cervix This lesion was discovered two months after exposure

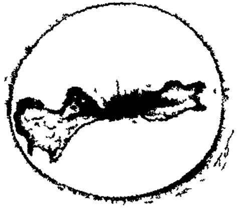


Fig 645 —Late syphilitic lesion of the cervix

a small fissure or a minute abrasion The positive diagnosis rests upon demonstration of the organism in darkfield examination since serological tests cannot be expected to become positive for another two to four weeks

Secondary Syphilis —During the secondary stage the vulva is commonly the site for the formation of *moist papules* which often go on to develop into broader *mucous patches* and finally to *condylomata lata* Each and

every one of these is highly infectious darkfield examinations reveal myriads of treponemas Serological tests are of greater assistance during this phase of the infection for they should be consistently and definitively positive

Condylomata lata are quite characteristic manifestations occurring in those who are uncleanly The typical flat condyloma begins as a raised smooth papule with a moist eroded surface It gradually hypertrophies and takes on various forms such as buttonlike plaques and cauliflowerlike masses These appear on the labial folds and often on the inner aspects of the thighs At times they quite fill the vaginal vault

Tertiary Syphilis —Tertiary syphilis of the vulva makes it appearance as a *gumma* a lesion which is indurated edematous and ulcerated Later it undergoes necrosis and may form a *fistula* particularly when secondary infection has been superimposed Serologic tests are usually positive in the tertiary stage of the disease but a gumma may be present with clear blood A certain method of diagnosis in dealing with the gumma is the observation of the *therapeutic test* when iodides are administered

The broader discussions of syphilis and its methods of therapy are elsewhere detailed (p 331)



Fig 646 —Bubo in female with positive Frei test of forearm

LYMPHOPATHIA VENEREUM OF THE VULVA

The virus of lymphopathia venereum produces a small initial *papule vesicle* or *erosion* of vulva vagina or cervix The lesion appears a few days after sexual intercourse has transmitted the infection but its duration is so transitory that it usually passes unnoticed Within a month a low grade bilateral regional *lymphadenitis* occurs the inguinal glands fuse and tend to suppurate with reddening and softening of the overlying skin *fistula formation* is a common sequel In the female unlike the male the perirectal lymph nodes are also involved leading to *perirectal inflammation elephantiasis of the vulva* (*esthiomine*) and finally *rectal stricture* (p 1914)

Constitutional symptoms include fever chills lassitude anorexia and loss of weight As indicated elsewhere (p 471) arthritis meningitis peritonitis pleurisy and dermatoses occasionally are encountered

The *diagnosis* is made from the clinical findings and the presence of a positive Frei test (p 473) *syphilis* is excluded by negative darkfield (p 45) and serologic tests (p 337) *gonorrhea* and *chancroid* by smears and

cultures (p 2587) and granuloma inguinale by failure to demonstrate Donovan bodies (p 475)

Courses of prophylactic and curative *treatment* are accomplished by the systemic use of *sulfonamides* (p 88) Patients with acute adenitis are hospitalized and fluctuant nodes are aspirated or incised and drained In the presence of rectal stricture dilatation is attempted

HERPES SIMPLEX AND ZOSTER OF THE VULVA

Herpes simplex occurs in the premenstrual period or during pregnancy The lesions tend to recur and are often most annoying An attempt is made to dry the vesicles by the local application of alcohol

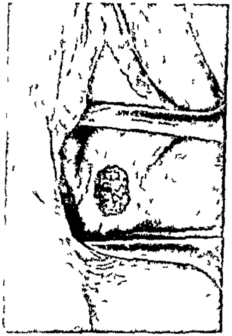


Fig 647 —Granuloma inguinale Early vaginal lesion of two weeks which contained Donovan bodies

The vesicle of *herpes zoster* has a more erythematous base and follows the path of the distribution of the nerve If pain is excessive alcohol injections are considered provided that relief cannot be obtained from the use of analgesics and opiates A more complete discussion of the herpetic viral diseases is included with the material on the *Infectious Diseases* (p 433)

GRANULOMA INGUINALE

Granuloma inguinale is caused by a leishmania like organism usually transmitted by coitus The disease is found especially in the tropics and the southern sections of the United States and is most frequent among Negroes The lesion is a chronic granuloma with a marked tendency to *ulceration* It affects the pudendal and inguinal regions and involves pri

* Drawing after photograph from life Patient of Dr Richard Torpin From Curtis, Textbook of Gynecology

marily the skin and mucous membranes rarely causing coincident adenopathy thus distinguishing this infection from lymphopathia venereum chancroid and primary syphilis

The characteristic lesion is a vivid shiny vegetating *nodule* composed of granulation tissue with a hemorrhagic surface The surrounding skin is thin and easily excoriated The local infection spreads by peripheral extension and auto inoculation There is little tendency to spontaneous healing and the lesion persists for many months or years

The *diagnosis* is made with certainty when scrapings taken from the deep tissues and stained by the Wright method (p 49) reveal *Donovan bodies* If this fails a biopsy is obtained and stained for the more certain recognition of the inclusion bodies



Fig 648 —Vulvitis (mycotic)



Fig 649 —Vaginitis (senile)



Fig 650 —Vulvovaginitis (senile)

The *differential diagnosis* is most clearly established when the dark field examination excludes the presence of syphilis and Frei test and blood serologic examinations are negative The practitioner remembers that the venereal diseases may coexist he does not commit himself as to a treatment schedule or prognosis until the results of all tests have been obtained The most complete discussion of granuloma inguinale appears in the chapter on *Infections* (p 475)

MYCOTIC VULVITIS

Mycotic vulvitis results from infection by *yeast* or *fungi* and is usually associated with or secondary to vaginal involvement The mycotic lesions

From *Research* Volume 5 G D Searle & Company courtesy of Dr Karl John Karnaky

are seen most often in children diabetics and the aged where the vaginal secretion loses its acidity and may even approach alkalinity

The *diagnosis* of mycosis is made by the growth of the yeast on suitable media The disturbance yields to the local application of 1 to 5 per cent gentian violet repeated at two day intervals

PEDICULOSIS PUBIS

Pediculosis pubis is usually acquired during sexual contact but may result from the use of a contaminated toilet seat or bed The diagnosis is

DIFFERENTIAL DIAGNOSIS OF

Pruritus Vulvae

Vulval itching is an annoying and embarrassing complaint that is very commonly encountered In most in tances the disturbance is of psychogenic origin unless it can be attributed to obvious local causation

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Psychogenic	Without local lesion
Hormonal	Hypogonadism (p 2523) Menopausal in association with leukoplakia and kraurosis vulvae (p 2597) Try use of e trogen (p 2515) Diabetes mellitus with glycosuria and hyperglycemia (p 1246) Hypothyroidism with low B M R and therapeutic re ponse to thyroid ext act
Mechanical and Chemical	Local soiling due to smegma urine and feces Lacerations fissures and fistulas (p 2534) Chemical irritations due to clothing and local or topical applications As the result of masturbation
With Dermatoses	Especially pediculosis pubis and scabies Look for parasites (p 3180) Lichen planus (p 3389) Psoriasis (p 3414) Intertrigo (p 3161) Urticaria (p 3345) Contact dermatitis Epidermophytosis (p 3295) Dermatitis medicamentosa due to phenolphthalein taken as a cathartic Look for lesions elsewhere
Infectious	All varieties of vulvovaginitis producing discharge (p 2585) Particularly monilial vaginitis and trichomonas vaginalis (p 2598) Get spreads and cultures
With Systemic Disease	Particularly cholemia uremia leukemia and Hodgkin s disease Check hemogram marrow smear and blood chemistry for icterus index, urea and glucose

established by finding *crabs* in pubic hairs Treatment is discussed in the section dealing with Tegumentary Disorders (p 3185)

SCABIES OF THE VULVA

Scabies of the vulva is characterized by the presence of *burrows* and *nocturnal itching* Treatment is detailed in the chapters dealing with Tegumentary Disturbances (p 3180)

ANALOGUES OF THE DERMATOSES

The vulva is of course covered with skin and is therefore subject to *the same dermatoses as the other body surfaces* The diagnosis and treatment of these conditions are not different because of their location Hence reference is made here for purposes of orientation

Lichen Planus—Lichen planus of the vulva produces the characteristic violaceous and itching *plaques* which are always associated with similar lesions elsewhere on the body *Treatment* is elsewhere detailed (p 3393)

Psoriasis—Psoriasis of the vulva and the intertrigenous areas is often seen and is most distressing because of the continued itching maceration of the scales and the production of moist lesions The *diagnosis* is established when the characteristic lesions are found elsewhere on the body (p 3414) *Treatment* is outlined in another section (p 3419)

Contact Dermatitis—Contact dermatitis of the vulval region is frequent Occasionally it arises from rubber or nylon panties

Intertrigo—A red or brown discoloration due to chafing between large and small labia and in the furrows between vulva and thighs is seen particularly in the obese diabetics and the uncleanly especially during hot weather The irritation is often increased or perpetuated by a vaginal discharge which requires treatment Often there is a complicating *teniasis* or *dermatophytosis*

Intertrigo readily responds to cleanliness and the frequent application of a dusting powder

Seborrhea—Seborrhea often occurs between the labia The accompanying excessive and offensive odor is eradicated by frequent cleansing and the use of a dusting powder

Sebaceous cysts are of frequent occurrence in the vulva They require excision under local anesthesia since infection is frequent due to trauma and irritation

Folliculitis and Furunculosis—Staphylococcic pyoderms result from the irritation of tight clothing uncleanliness the pressure of the vulva pad during menstruation and from less obvious causes in the debilitated Premature drainage of the purulent area results in a spread of the infection and perpetuation of the difficulty

If it is possible the area is kept completely dry and irritation is avoided by spending one or two days in bed Individual pustules are treated by the application of 5 per cent sulfathiazole ointment When suppuration threatens sitz baths assist in heading the infection The application of pure phenol on the end of a probe permits removal of the core without spread of the infecting organism

Relapses are apt to occur unless the treatment is protracted and repeated

Condylomata Acuminata—Condylomata acuminata are multiple soft excrescences that appear about the vulva and perineal regions They occur especially during pregnancy and may follow persistent irritating discharges Condylomata are viral in origin and are not venereal The superficial lesions may be removed by sharp excision or electrocoagulation under local anesthesia Recurrence is frequent hence postoperative treatment consists of scrupulous cleanliness

SENILE ATROPHY OF THE VULVA

Senile atrophy of the vulva is physiologic and follows cessation of ovarian function after the menopause There is a moderate shrinkage of the external genitals Often there is an accompanying *senile vaginitis* (p 2600)



Fig 651 —Trichomonas vaginalis *(low power microscopic field)* *



Fig 652 —Vaginitis *(trichomonal)*



Fig 653 —Cervicovaginitis (trichomonal)



Fig 654 —Vulvovaginitis (trichomonal)



Fig 655 —Endocervicitis *



Fig 656 —Cervicovaginitis

which may result from lessening of lactic acid protection against bacterial infection The vaginitis is accompanied by burning and itching

Estrogenic therapy (p 2516) is often helpful the hormone may be given intramuscularly orally or by vaginal suppositories

* From *Research* Volume 5 G D Searle & Company courtesy of Dr Karl John Karnaky

KRAUROSIS VULVAE

Kraurosis vulvae is an exaggerated shrinking and atrophy of the vulva *similar to the process in senile vaginitis* (p 2600) The epidermis becomes thin and atrophic papillae are low or effaced the corium is cirrhotic with round and plasma cell infiltration hair follicles sweat glands and sebaceous glands are atrophic or absent

Labia clitoris and prepuce appear shrunken the introitus is constricted and there is accompanying *dyspareunia* (p 2491) The vulval skin is thin white glistening dry and frequently pigmented Because of its brittleness the skin exhibits cracks fissures and excoriations *Leukoplakia* (p 2597) may be present as a precancerous lesion leading to the development of a *squamous cell carcinoma* (p 2549) The most intense symptom is the intractable *itching* (p 2594)

In its early stages kraurosis vulvae may be successfully treated with large doses of *estrogen* In neglected instances particularly with leukoplakia *complete vulvectomy is indicated for relief of symptoms and prevention* of carcinomatous degeneration

ELEPHANTIASIS OF THE VULVA

Edema of the vulva occurs with local inflammation angioneurotic afflictions cardiac failure and thrombosis of the pelvic veins When lymph stasis is excessive elephantiasis results The tropical form which is not observed in the United States is usually due to lymphatic blockage by the *Filaria sanguinis hominis* (p 3321) In this country syphilis and lymphopathia venereum produce a similar process which may require excision of the diseased area and vulvectomy

LEUKOPLAKIA

Leukoplakia of the vulva appears as a white thickened patch It is often superimposed upon an atrophic or kraurotic vulva

Leukoplakia results from prolonged irritation and is a definite *precancerous lesion* Local excision is highly desirable and if histologic study reveals any suspicion of malignancy complete *vulvectomy* and *roentgen therapy* are required

ACUTE NONSPECIFIC VAGINITIS

Nonspecific vaginitis is an acute inflammatory process that is not caused by any of the venereal organisms It may result from the use of irritant chemicals in douches tablets or suppositories and is not uncommon in diabetics and patients with debilitating disease

The clinical picture is marked by burning pain and a purulent *vaginal discharge* Examination reveals redness and hyperemia with irritation of the vulva

The *diagnosis* of simple vaginitis requires the exclusion of the possible presence of venereal organisms fungi and trichomonas Hanging drop preparations stained spreads cultures skin tests and darkfield microscopy are required (p 45) The lesion heals with elimination of the cause and the use of cleansing douches

GONORRHEAL VULVOVAGINITIS

See p 2586

SYPHILIS OF THE VAGINA

See p 2589

LYMPHOPATHIA VENEREUM OF THE VAGINA

See p 2591

MYCOTIC VAGINITIS (FUNGUS OR MONILIAL VAGINITIS)

Fungi and yeasts are found in the vaginas of 10 per cent of nonpregnant women and one third of those who are gravid These organisms are capable of producing an inflammatory reaction at the extremes of life and in diabetics whose vaginal secretions deviate from the normal acid reaction (p 1246)

In addition to the usual signs of vaginitis there may be found thrush like patches on vaginal and vulval surfaces From these the organism may be identified by direct microscopy (p 50) or culture

Treatment—The treatment of monilial vaginitis is most unsatisfactory unless the *p*H of the vagina can be restored to its normal optimum In the meantime 1 to 5 per cent gentian violet is applied locally and the remedies employed for trichomonas infestation (p 2599) are used

TRICHOMONAS VAGINITIS

Infestation of the vagina with *Trichomonas vaginalis* a flagellated protozoon gives rise to vaginal inflammation associated with profuse leukorrhea and an offensive odor Pruritus of the vulva is frequent The disease is very common and constitutes one of the most frequent causes of *vaginal discharge* It is also an occasional cause of *acute balanoposthitis* and *urethritis* in the male (p 2338)

Etiology—*Trichomonas vaginalis* is a motile flagellated pear shaped protozoon which is frequently found in vaginal secretions and the stool and urine of normal females Factors which decrease the *p*H of the vagina such as estrogen or vitamin deficiency and diabetes increase the ability of the organism to survive in the vagina and to invade the tissues The disease is highly infectious and may be transmitted by a common douche bag or bath tub The male genitals are infected during sexual intercourse and may be the source both for the primary infestation and for recurrences The intestinal organism *Trichomonas hominis* does not normally invade the vagina it may be introduced by faulty anal hygiene in which toilet paper is wiped from behind forward instead of from before backwards

Clinical Manifestations—The clinical features of trichomonas vaginitis are similar to those of simple vaginitis There is a profuse white irritating *vaginal discharge* which is characteristically foamy The patient complains of *soreness itching* and *dyspareunia* Vaginal and cervical mucous membranes are red congested and granular The vulval regions are reddened and chafed

Diagnosis—The diagnosis is established by introducing a bivalve speculum *without the aid of a lubricant* A drop of the discharge is taken from the concave posterior blade mixed with a drop of normal saline and ex

amined microscopically The organism is pear shaped and measures about 12 to 25 micra Three flagella project anteriorly and a fourth forms the border of the undulating membrane The flagellate moves with an irregular circular or spinning motion

Treatment—The treatment of *trichonomas vaginalis infestation* requires persistence and complete cooperation from patient and husband Correct rectal hygiene is stressed requiring that the anus be wiped from before backward rather than from behind forward The penis of the sexual part ner is examined and if there is a tight foreskin with trichomonas organ isms demonstrable behind the head of the penis the male is urged to have a *circumcision* (p 3936) *Otherwise the area is scrubbed daily with Tincture* of Green Soap and painted with 1 to 5 per cent Gentian Violet

Active treatment requires dogged persistence on the part of physician and patient The vagina must be thoroughly scrubbed with green soap with particular emphasis upon all recesses After drying one of several powders is insufflated using a special powder blower A popular prescription con tains 12 parts of acetarsone (*Stovarsol*) 2 parts of salicylic acid and equal parts of kaolin and sodium bicarbonate to make 100 parts There is also commercially available a *silver picrate* powder which seems equally effec tive The powder insufflations are administered at least twice weekly In order to prevent a recurrence following the menstrual period one insuffla tion on the second or third menstrual day is advisable

Office treatment yields little promise of a success unless the patient is equally persistent in her administrations She is requested to take daily douches of *hypertonic sodium chloride* or *lactic acid* The hypertonic saline douches are prepared by dissolving one half tumbler of table salt in two quarts of warm water the strength of the salt is gradually increased until two tumblerfuls of salt are employed for the two quart douche bag With lactic acid 1 teaspoonful of the U.S P preparation is placed in two quarts of warm water and the strength is increased until 3 or 4 teaspoonfuls are employed night and morning

Home therapy is supplemented by the use of commercially available vaginal tablets containing acetarsone or diodoquin as the active agent or of *suppositories* containing picric acid according to the following formula

℞	
Picric acid	0 04
Oxyquinoline sulfate	0 04
Menthol	0 01
Cocoa butter to make	4.0

M 12 vaginal suppositories each containing the above amount of ingredients

These vaginal tablets or suppositories should be used during the menstrual period Lactic acid vaginal jelly may be introduced each night by means of a vaginal *applicator*

If one form of treatment fails another is instituted substituting which ever drug has not been employed in the first instance Patients are warned of possible recurrences and cautioned that treatment must not be discon tinued until the vaginal secretion fails to yield the parasite and the lesion of the male penis is similarly free from evidences of the invading intruders Lactic acid douches are recommended during and after each period as a measure of prophylaxis

SENILE VAGINITIS

Diminution in estrogenic stimulation of the vaginal mucosa which occurs physiologically after the menopause may result in markedly atrophic changes The vaginal wall appears thin, pale and glistening with tiny areas of hemorrhage or ulceration Itching burning soreness dyspareunia and a thin leukorrhea occasionally blood tinged may be present

Estrogenic therapy (p 2516) is employed by intramuscular injections and vaginal suppository Lactic acid douches and sitz baths afford some symptomatic relief

ACUTE NONSPECIFIC CERVICITIS AND ENDOCERVICITIS

Acute cervicitis and endocervicitis are usually of *gonorrheal origin* (p 2601) On rare occasions a nonspecific variety results from trauma during childbirth or after instrumentation or the insertion of a stem pessary

The diagnosis of an acute nonspecific cervicitis is not considered unless smears and cultures for gonococci have proved to be negative the hanging drop preparations fail to reveal the trichomonas (p 2598), darkfield microscopy shows no characteristic treponemas and Frei test and serologic reactions are negative

Nonspecific cervicitis yields to elimination of causative factors and local applications of sulfanilamide powder silver nitrate or gentian violet

CHRONIC NONSPECIFIC CERVICITIS AND ENDOCERVICITIS

The cervix is frequently the site of a protracted inflammatory process which results from a nonspecific infection with various strains of streptococci and other organisms present in the vagina Cervical infections due to gonorrhea syphilis and tuberculosis are discussed elsewhere (p 2601) Chronic cervicitis is an extremely common condition and is a prominent cause of *leukorrhea* and *sterility* There is suggestive evidence that the chronically inflamed cervix is particularly susceptible to *malignant disease* (p 2551)

Etiology —The commonest cause of cervical infection is trauma incident to childbirth which produces laceration eversion of the glandular mucosa ulceration and erosion (p 2534) Other causes include the presence of a stem pessary surgical procedures (cervical amputations) radium applications douches and violent sexual intercourse Hypersecretion of the cervical glands from emotional and endocrine causes leads to maceration of cervical mucosa and cervical erosions which favor bacterial invasion

Clinical Manifestations —The principal symptom of chronic endocervicitis is profuse yellow *cervical discharge* which is stringy and mucopurulent The patient notices stains on her underclothes and is often chafed by the moisture In some instances it may be necessary to wear a sanitary pad almost continually Obstruction to the cervical canal may be attended by systemic symptoms such as backache malaise or anorexia *Urinary tract infections* are common due to the ease with which infected material is introduced into the short urethra *Sterility* (p 2492) results from inability of sperm to traverse the infected cervical mucous plug

The cervix may be transversely *lacerated* (fish mouth) with the formation of reddened vascular *erosions* on the vaginal surface There may

be a velvety polypoid overgrowth of the mucosa and in many cases *retention cysts* (nabothian) are seen (p 2550) The thick tenacious yellow *mucous plug* often is quite difficult to remove Occasionally the patient may be embarrassed by the sudden emission of a large plug of mucopurulent material

Treatment—When the pathologic process is of a mild degree the caustic effect of 10 to 20 per cent silver nitrate applied by a cotton applicator is tried at weekly or biweekly intervals To avoid caustics which carry the risk of cervical stenosis mild cleansing saline douches may be substituted

Cauterization of the cervix for the treatment of erosion and of the endocervix for the treatment of endocervicitis should be done during the intermenstrual period avoiding the menstrual week. The patient is placed in the gynecologic position and a bivalve speculum is introduced to secure complete exposure of the cervix Vagina and cervix are wiped clean If a tenacious cervical plug is present it is best removed by suction a paste of bicarbonate of soda or the application of hydrogen peroxide It is unnecessary to paint the cervix with alcohol or alcoholic solutions especially with the possibility of ignition

If *electrocoagulation* is employed a depth of 2 mm is sufficient coagulation The cautery tip is heated to a dull red and the strokes of the tip or blade are made in radial fashion about the entire circumference of the cervix ending just within the external os

The endocervix is treated with a thin long tip which is stroked along the endocervical canal in linear fashion at intervals of a few millimeters Several visits may be required to complete the cauterization Too large an area should not be cauterized at one time because of the danger of producing stenosis of the cervix

Following the procedure cervix and vagina are cleansed If slight bleeding is present vaginal gauze is inserted and removed after several hours The patient is cautioned concerning the possibility of bleeding and the probability of increased vaginal discharge for several days Daily douches are prescribed with 1 5000 potassium permanganate

In severe examples *linear cauterization* and *electrocoagulation* are productive of fairly good results Care should be taken to avoid cervical strictures In selected cases surgical repair (trachelorrhaphy cervical amputation) of the diseased endocervix is required These operations are reserved for women beyond the childbearing age

GONORRHEAL CERVICITIS

The commonest cause of acute cervicitis is an acute gonorrheal infection Whereas formerly principal attention was directed to the participation of the urethra it has become increasingly apparent that cervical involvement is almost universal In consequence diagnostic specimens are taken from the cervix as well as the urethra in each suspect

The gonorrheal infection is characterized by a thick yellow *profuse leukorrhea* (p 2585) Speculum examination reveals congestion and swelling of the cervix The external os is surrounded by a red granular erosion covered by purulent material The endocervical canal usually contains tenacious yellow purulent material

Specimens are obtained by twisting a cotton applicator within the cervical canal Smears are obtained by the Gram method and cultures are made as previously described (p 49) There is usually a coexistent urethritis skenitis or bartholinitis

Treatment is elsewhere described (p 2587)

TUBERCULOSIS OF THE CERVIX

Tuberculosis of the cervix is uncommon and is almost always secondary to infection of adnexa or uterus (p 2610) Grossly the lesion suggests a neoplasm and may present hyperplastic polypoid nodular or ulcerative characteristics Leukorrhea (p 2585) may be present in addition to the symptoms of tubal or uterine infection Diagnosis is made by biopsy and sections stained to demonstrate the organism

With cervical enlargement *panhysterectomy* is advisable unless the general condition of the patient is such that this procedure is excessively hazardous

SYPHILIS OF THE CERVIX

All stages of syphilis occur in the cervix The relative frequency of *cervical chancre* is estimated between 1 5 and 8 per cent These figures are naturally unreliable since the lesion most often escapes detection Because of the lymphatic drainage to the pelvis inguinal node enlargement is not found which further obscures early diagnosis

The cervical chancre usually escapes recognition unless a speculum is used *when syphilis is suspected It is often centrally* placed near the external os it is more often seen on the posterior lip and may appear as a small macule or a large swollen indurated ulcer The cervix may be greatly swollen with an indurated elastic consistency The lesion tends to be larger and more indurated in the gravid female Cervical chancres are commonly mistaken for erosions and malignant lesions

The *tertiary gumma of syphilis* causes considerable necrosis and ulceration with secondary infection Cervical gummas appear at some distance from the external os and have a sharp outline There is a noticeable absence of a perifocal inflammatory reaction and the lesion is easily mistaken for a cancer The diagnosis is established by serologic and therapeutic tests Persistence of the lesion after therapy suggests the possible presence of a malignancy in a syphilitic woman and a biopsy is indicated

LYMPHOPATHIA VENEREUM OF THE CERVIX

See p 2591

GRANULOMA INGUINALE OF THE CERVIX

See p 2192

TRICHOMONAS OF THE CERVIX

See p 2598

PUERPERAL ENDOMETRITIS

Puerperal infection results from invasion of the birth passages by pathogenic bacteria The contamination may occur during or following parturition

Pathogenesis —The parturient uterus is essentially a large open vascular wound Organisms gain entrance to the cavity through the relaxed and stretched cervical os Numerous traumatized areas such as are inevitably present due to pressure of the fetal head and laceration afford an excellent medium for the initial growth of bacteria

Exogenous Infection —Exogenous infections are introduced by hospital attendants nurses and physicians who harbor *hemolytic streptococci* (p 158) in their respiratory passages The monumental contribution of Semmelweis advocated so heroically and strenuously by Oliver Wendell Holmes placed the onus for puerperal fever on those to whom the care of the parturient had been entrusted The woman who is delivered in her home has fewer contacts and hence enjoys a greater measure of safety from this viewpoint

In the modern obstetrical hospital those who come in contact with the woman in labor must be adequately masked Carriers of hemolytic streptococci should be excluded from participation in the procedures of childbirth It is wise additionally to ban those who have had a recent upper respiratory infection

Endogenous Infection —Pathogenic invaders may gain entrance through the vagina by frequent digital exploration before and during labor Even rectal examination has an inherent danger since the contaminated vaginal wall is pushed into the cervical os Organisms may be introduced by the patient s fingers vaginal douches bedpans catheterization and instrumentation The incidence of infection increases with the duration of labor and is appreciably higher where it is necessary to resort to instrumentation to terminate labor Consequently the obstetrician should perform elective surgery early in the course of childbirth rather than later when there have been greater opportunities for the introduction of bacteria and the resistance of the local tissues has been lessened by trauma

Systemic factors which predispose to bacterial invasion include the physical strain of childbirth loss of fluid and blood that inevitably is experienced and possibly certain endocrine disturbances which upset hormonal equilibrium

Bacteriology —Although a great many organisms have been isolated from patients with puerperal sepsis the principal causative agent is the *beta hemolytic streptococcus* (p 158) Other organisms which have been incriminated include staphylococci colon bacilli gonococci and clostridia

Pathology.—Puerperal sepsis is a manifestation of a wound infection Although any local contusion or laceration may become the portal the infection usually begins at the *placental site* and spreads quickly via the open blood sinuses and the numerous lymphatics to adjacent pelvic structures and peritoneum

Endometritis —Puerperal endometritis is characterized by swelling and necrosis of the endometrial remnants and is associated with a foul purulent discharge (p 2585) In mild infections the process may fail to extend further but more virulent organisms may invade *myometrium parametrium* and *peritoneum* The *uterine muscle* becomes swollen hyperemic and infiltrated with a cellular exudate There are numerous abscesses of varying size and portions of the uterine wall become gangrenous as the result of superimposed fusospirochetal infection with the production of *metritis dessicans*

Parametritis and Pelvic Abscess —In many cases the *parametrial tissues* are hyperemic swollen and the site of a brawny tender exudate the uterus becomes fixed and the broad ligaments are swollen the exudate may extend posteriorly upward beneath the peritoneum Commonly it extends outward to the pelvic wall and then upward between peritoneum and

abdominal wall As a rule the exudate undergoes resolution but *pelvic abscesses* are common these may rupture in the inguinal region in the neighborhood of Poupart's ligament or into peritoneum vagina or the region of the iliac crest

Pelvic Peritonitis—*Inflammation* of the *peritoneum* may remain localized as a *pelvic peritonitis* or it may spread rapidly to involve the entire cavity (p 1023) The tubes and ovaries rarely become extensively involved although there may be an appreciable degree of *perisalpingitis* or an *ovarian abscess* As a rule the inflammatory process in these organs subsides completely with little residual damage

Thrombophlebitis—Invasion of the pelvic veins almost invariably occurs and may overshadow the local progress of the infection as the result of breaking down of infected venous thrombi in the uterine wall and their passage to the deep veins *Septic thrombophlebitis*



Fig 657—Retained products of gestation and necrosis in corpus of uterus Thrombophlebitis of the uterine veins The majority of patients with postabortive and puerperal infection suffer from at least minor lesions of the pelvic veins *

tends to extend to iliac and femoral veins and at times to inferior vena cava Small infected thrombi gain entrance to the systemic circulation and give rise to metastatic abscesses in lungs and liver Common complications include *lung abscess pneumonia massive pulmonary infarction* and *pylephlebitis* Extension to the *femoral vein* leads to its occlusion and the painful swelling of the lower extremity known as *phlegmasia alba dolens* (p 2648)

Vulvitis and Vaginitis—In some instances the infection may remain localized in a perineal or labial laceration The wounds have a yellowish granular surface with a foul purulent exudate There is swelling and redness of surrounding tissues and extensive *vulvitis* or *vaginitis* Occasionally the entire vaginal mucosa is red swollen and covered with a purulent discharge A diphtheritic membrane may involve the whole vagina

Late Sequels—Following the subsidence of the acute infection there are usually abdominal and pelvic *adhesions* and *chronic infection* of tubes parametrium endometrium and

* Curtis, Textbook of Gynecology

cervix Recurrent *pelvic abscesses* are fairly common As a rule, the fallopian tubes are not occluded in sharp contrast to infections caused by gonorrhea and tuberculosis In many patients, an abscess may remain undetected for years in the extraperitoneal space (R Iz us or between the layers of the broad ligament, causing chronic ill health

Clinical Manifestations.—The clinical picture of puerperal sepsis is that of systemic infection The severity depends on the extent of the process, the virulence of the causative organism and the patient reaction

Typically after the subsidence of the immediate febrile reaction associated with parturition the *temperature* rises above 100 4° F and tends to increase as the days pass The chart has an irregular appearance due to evening spikes and morning remissions *Chilly sensations* and severe *chills* are noted as well as *headache malaise* and *anorexia* The pulse is rapid and of fair quality but in severe infections it quickly becomes soft and difficult to detect The *uterus* is enlarged and tender the *lochia* may or may not be diminished and may have a normal or a foul odor In the presence of a *parametritis* the uterus is fixed by a tender brawny unyielding sensitive mass in the base of one or both broad ligaments It may be felt as a tender fullness in the posterior fornix or above Poupart s ligament

With the occurrence of *peritonitis* the general condition of the patient quickly deteriorates and there are the signs of an acute diffuse inflammation (p 1923)

The onset of *thrombophlebitis* is heralded by a sudden spike in temperature attended by a severe *chill* occurring about a week after delivery Recurring chills and a spiking temperature are characteristic as are the later signs of a pulmonary complication In some patients there are recurrences of thrombophlebitis separated by afebrile periods

In infections due to anaerobic streptococci the process consists of a localized endometritis characterized clinically by a slight fever on the third or fourth day and a foul heavy lochia As a rule the *condition clears* spontaneously in five or six days

Prognosis—With the advent of modern obstetrical methods and the use of sulfonamide drugs and penicillin the prognosis of puerperal sepsis has become more favorable and ultimate recovery is the rule Peritonitis is still a dread complication with a high mortality and a protracted course Thrombophlebitis gives rise to the ever present threat of pulmonary embolism and tends to damage the venous mechanism of the lower extremities leading to painful varicosities

Treatment—The conquest of puerperal sepsis has been accomplished by recognition of the teachings of Semmelweis and Holmes and the more recent introduction of anti infective agents The first of these landmarks in medicine pointed the way to prevention anti infective agents accomplish the cure of those who have become infected

Prophylaxis—The prevention of puerperal sepsis as previously indicated in the section on pathogenesis (p 2603) requires the elimination of exogenous and endogenous factors productive of bacterial invasion It is the duty of the physician to eliminate from the handling of his patients any attendant who has visible open sores or wounds a history of recent respiratory infection or nasopharyngeal cultures from which hemolytic streptococci can be isolated This requires considerable vigilance and most

of us unfortunately become altogether too careless in relation to bacterial contamination (p 2603) We are so constantly exposed to infectious disease that it does not occur to us that we may be potential or actual carriers of disease to our immediate families and our patients The relative infrequency with which we ourselves develop evidence of actual infection lulls us into a sense of false security and we overlook the possibility that we have become "healthy carriers" (p 161) Practitioners may safeguard the health of their patients by insisting that the administrative officials of their local hospitals order routine surveys of operating and delivery room personnel at fortnightly or monthly intervals Only in this way can standards be maintained

Prophylaxis additionally requires *minimal instrumentation or examination* of the woman in labor and the practice of *rigid asepsis* in the performance of even the most minor procedures Necessary surgery is performed early rather than late in the course of the parturition and when indicated the tissues are protected by infusion transfusion and *preventive therapy* with sulfonamide and/or penicillin (p 106)

Active Therapy—The active treatment of puerperal sepsis is best accomplished by setting up an intravenous drip After 100 cc of 5 per cent *sulfadiazine* have been introduced *penicillin* is given in saline solution at an hourly rate of 20 000 units Streptomycin (p 104) is substituted or added if symptoms persist or the invading organism is a coliform bacillus The bed is placed in Fowler s position to facilitate drainage Pain is allayed by the local use of an icebag and the administration of opiates where necessary Transfusion of blood is considered for supportive treatment as well as the correction of anemia Surgical intervention should be limited to drainage of an obviously fluctuant and localized abscess

When there is a complicating thrombophlebitis the efficacy of the anti infective therapy is enhanced and embolization is prevented by simultaneous *heparinization* (p 1050) preferably using the subcutaneous deposits employed in the Loewe treatment of subacute bacterial endocarditis (p 1024)

SEPTIC OR POSTABORTAL ENDOMETRITIS

Dilatation and curettage practiced under operating room conditions such as prevail in the therapeutic abortion (p 2649) have little risk but septic abortion may follow illegal termination of pregnancy The majority of women who succumb to postabortal endometritis have undergone an operative procedure performed under illicit circumstances The usual history is that of an unwanted pregnancy and a visit to a midwife or an illegal abortionist within or without the medical profession With or without general anesthesia a foreign body is inserted into the uterus or an actual curettage is performed The woman rests at most for a few hours in the office and then returns to her home It requires but little imagination to realize the risks that are involved both immediate and late

The incidence of criminal abortion (p 2650) cannot be accurately estimated In our own experience it would be a fair approximation to state that there is one abortion for each childbirth While it is true that the percentage of septic tragedies is relatively inconsequential the total number of women in the United States who annually lose their lives due to

postabortal sepsis is appalling and probably the figure exceeds the statis tical survey since many incidents do not come to light The sum of human tragedy in terms of individual lives is heartbreaking particularly when the immediate consequences are augmented by the sterility of those who have been made barren by injudicious management.

Etiology and Pathogenesis—In postabortal endometritis organisms are introduced by instrumentation Compared to puerperal sepsis there is a disproportionately lesser incidence of streptococcal infection and a higher incidence of invasion by *clostridia* of the Welch and tetanus types

Pathology—As in puerperal sepsis the *uterus* becomes enlarged as a result of an acute inflammatory edema There is extensive *endometritis* and suppurative *metritis* The placental site is often necrotic and covered with a pseudomembrane The *parametrial tissues* are in



Fig 658.—Typical picture of inflammatory changes which follow severe postabortive infection The opened fibrotic uterus contains a small fibroid Diffuse cellulitis Tubes and ovaries buried in massive firm adhesions

volved and there is frequent *infection* and *thrombosis of the deep veins Ovarian abscesses* are observed as well as *pelvic collections of pus* Late aftermaths include scarring and stenosis of cervix and tubes leading to *sterility*

Clinical Manifestations—The possibility of postabortal sepsis must be considered in each instance of infection of unknown origin occurring in a young woman While some patients will give an honest and straightfor ward history others will seek to conceal the fact and even deny the truth when confronted with it The physician owes it to his patient and himself to conduct a visual examination of the cervix even if the patient is un married or living apart from her husband Telltale marks of instrumenta tion are often visible and the discharge is often profuse foul smelling and purulent The *systemic manifestations* do not differ from those of puer peral sepsis (p 2602)

Treatment —In accordance with legal demands and for his own protection the practitioner is required to report a septic abortion to local health authorities Only in this way is he protected, if the patient suffers invalidism or death Despite the heaviest and most dramatic pressure that is brought to bear the situation demands police investigation Failure to heed this precept may cost the practitioner his license to practice medicine and his freedom

The systemic treatment of post abortal sepsis is similar to that used in puerperal fever (p 2606) With retention of infected material it may be necessary to dilate the cervix Instrumental interference is occasionally indicated using a blunt curette Packing is avoided but a vaginal suppository of penicillin (100 000 to 300 000 units) may be introduced

GONORRHEAL ENDOMETRITIS

See p 2608

TUBERCULOUS ENDOMETRITIS

See p 2610

GONORRHEAL SALPINGO OOPHORITIS AND PELVIC PERITONITIS

Acute gonorrheal infection of the upper genital tract occurs about two or three weeks following initial infection the more obvious involvement is that of the *fallopian tubes* The symptoms and signs of tubal involvement are very often seen at the end of menstruation or shortly thereafter In all likelihood the presence of menstrual blood favors the ascent of organisms from the cervix

Clinical Manifestations —The involvement of the upper tract is suspected when the infected patient complains of *fever nausea vomiting* and *severe lower abdominal pain* Examination reveals tenderness in right and/or left lower quadrants (p 1880) Evidences of peritoneal irritation become manifest from muscle spasm and the presence of rebound tenderness Movement of cervix or uterus on bimanual examination elicits pain The adnexal region is tender and the tubal areas appear thickened In some instances a tender soft swelling is present in the posterior fornix indicating the presence of pelvic or peritoneal involvement

Diagnosis —With unilateral right sided salpingitis the simulation of *acute appendicitis* is marked (p 1881) The frequent coexistence of the two conditions adds to the diagnostic difficulties The practitioner should be guided by the axiom that it is better to perform an unnecessary laparotomy for salpingitis than neglect an acute appendicitis

Course —The course of acute salpingo-oophoritis is variable and has been greatly modified by the introduction of anti infective agents Previously the condition would subside with fairly complete resolution within a few days or weeks In many instances however the tubes became occluded internally or externally by adhesions which gave rise later to sterility (p 2492) Adhesions in the pelvic peritoneum often produce retroversion of the uterus

Treatment —With evidences of involvement of the upper genital tract the patient is placed in bed and treated intensively with sulfadiazine and/or penicillin (p 106) When all evidences of infection have disap-

peared smears and cultures are taken from urethra ducts of Skene and Bartholin and cervix The patient is requested to return at two week intervals and later monthly intervals for at least half a year before being finally discharged Post menstrual specimens are of greater importance

Chronic Gonorrheal Infections—Chronic gonorrheal infection of the upper genital tract may be characterized by persistent low grade inflam mation recurrent bouts of fever or the appearance of localized pockets of pus

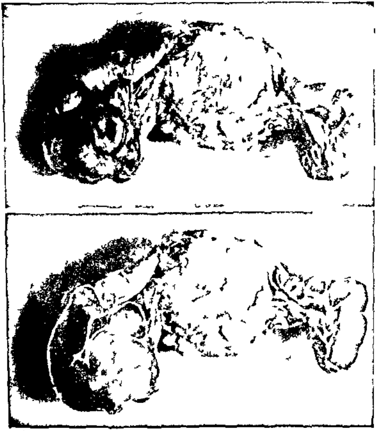


Fig 6 9—Bilateral chronic gonococcal salpingitis Much of the purulent exudate has been replaced by a gelatinous mass

Despite the chronicity of the infection intensive treatment with sulfa diazine and/or penicillin may yield surprisingly favorable results Surgical treatment must not be neglected and *pelvic abscesses* are incised and drained as soon as suppuration is clearly demonstrable The preferred technic is posterior colpotomy Indications for *intra abdominal surgery* include painful displacement of the uterus adhesions causing dysmenor rhea sterility continued uterine bleeding the presence of a large hydro salpinx or tubo ovarian cyst and persistent tubo ovarian abscess

TUBERCULOUS SALPINGO OOPHORITIS AND ENDOMETRITIS

The reproductive organs are not infrequently the site of a localized chronic tuberculous process Approximately 5 per cent of all pelvic infections requiring operative intervention are tuberculous in origin (Curtis) According to Wharton only lungs intestinal tract and peritoneum are involved more often than the female genital tract

Pathology—Genital tuberculosis in the female is *hematogenous* in origin A primary focus is usually present in lungs mediastinum or intestinal tract In contrast to gonorrhea, the infection is essentially of the internal genitals The *fallopian tubes* are always involved,

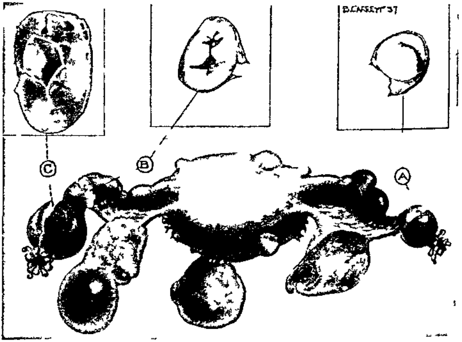


Fig 660—Tuberculous pyosalpinx bilateral tuberculous endometritis This is the commonest type of tuberculous salpingitis There are few if any peritoneal tubercles Both tubes contain firm caseous material The external appearance does not suggest tuberculosis opening the fallopian tubes would have revealed the diagnosis

In addition this patient had other gynecologic lesions as shown above uterine myomas and bilateral follicular cysts of the ovaries There is also a ruptured tubal pregnancy the only case in this hospital in which tubal pregnancy has been associated with tubal tuberculosis

A and *B* are cross sections through the caseous fallopian tubes *C* is a cross section through the ruptured tubal pregnancy *

the *uterus* is infected in about 75 per cent of patients and the *ovaries* less commonly Cervix vagina and vulva hardly ever participate in the process

The infectious process starts in the *tubes* which become nodular thickened and indurated There are numerous dense adhesions to adjacent structures The fimbriated extremities remain patent and are everted in about 50 per cent of the cases In the rest, the ends of the tubes are closed and *hydrosalpinx* or *pyosalpinx* are inevitable sequels

The infection spreads from tubes to *uterus* and *ovaries* There is an extensive *endometritis* with large irregular ulcerations which give rise to a profuse *leukorrhea* (p 2061) *Perioophoritis* is common and caseous *tubo-ovarian abscesses* may be encountered The *cervix* which is rarely affected may be the site of a tuberculous ulcer or a fungating granu

* Gyn Path No 44501 Stevenson and Wharton Am J Obst & Gynec 37

loma *Vagina* and *vulva* uncommon foci may present dirty indolent ulcerations with papillary formation

It is difficult to distinguish pelvic tuberculosis from an extensive chronic gonorrhea without microscopic demonstration of tuberculous granulation tissue and acid fast organisms. A positive identification of cervical, vaginal and vulval lesions requires biopsy of the suspected areas.

Clinical Manifestations—The clinical picture of genital tuberculosis lacks specificity and is essentially that of a chronic pelvic infection. The principal local manifestations are *lower abdominal pain, leukorrhea and menstrual irregularities*, especially *oligomenorrhea* and *amenorrhea* occurring in a woman with known tuberculosis. Additionally the patient presents evidences of a chronic infection such as malaise, anorexia, low grade pyrexia and weight loss.

The physical findings depend on the stage of the disease. During the acute phase there may be nothing more than vague *fullness* and *tenderness* in the adnexal regions. In the later stages the uterus may be fixed and large *masses* are felt on abdominal and pelvic examination. Vaginal and intestinal *fistulas* may be present and there is often considerable *abdominal distention*. At times free fluid is present in the peritoneal cavity indicating an accompanying *tuberculous peritonitis* (p 1930). The appearance of the rare cervical, vaginal and vulval lesions aids in the recognition of the condition.

Diagnosis—A positive clinical diagnosis of genital tuberculosis can only be inferential before exploratory laparotomy. Even at operation the nature of the pathological process is difficult to determine. Helpful differential points include a history of intestinal, pulmonary or renal tuberculosis, a rapid sedimentation rate, a moderate anemia, firm adhesions, areas of calcification and patent fallopian tubes. The tuberculous patient, just as her nontuberculous sister, may be afflicted with gonorrhea or suffer a malignant genital lesion.

Treatment—When active pulmonary, intestinal, peritoneal or urinary tuberculosis is present, a conservative regimen is adopted. An intensive course of anti-infective therapy with streptomycin (p 103) is worthy of trial. At least 0.5 gm at four or six hour intervals is given for at least two months. If the disease is limited to the pelvis and the process is inactive, *surgical removal* of the tubes, uterus and ovaries is advised. Operation is always attended by the danger of dissemination and may be followed by fistula formation and secondary infection. *Roentgen therapy* has its advocates and, according to Curtis, has gradually become the treatment of choice. *Pneumoperitoneum* is believed of value by Stein.

The prognosis in properly selected cases is good. Surgical removal of the infected organs resulted in improvement in 75 per cent of Wharton's patients.

SYPHILIS OF THE UPPER GENITAL TRACT

Syphilis of the uterine body, fallopian tubes and ovaries undoubtedly exists but is a rarity. It has been said that the uterus is highly immune to syphilitic infection. Uterine hemorrhage is a fairly frequent finding in luetic females but the exact cause is obscure.

Disturbances of the upper genital tract discovered in luetic females

are more likely unrelated to the syphilitic infection A coexistent gonorrhea or tuberculosis should be suspected

MUMPS OOPHORITIS

The virus which causes *epidemic parotitis* (p 480) produces secondary complications in the ovaries just as it affects the testes of the male (p 2464) The diagnosis is less often apparent, but should be suspected if the patient develops lower abdominal pain and the course of mumps is stormy or followed by a rise in temperature after parotid swellings have subsided

All too frequently the ovaries become atrophic, as manifested later by *sterility* (p 2492) and *hypogonadism* (p 2523)

The early use of *mumps convalescent serum* (p 483) may cut down the incidence of secondary oophoritis Once the complication has developed however serum is of no avail

PELVIC PERITONITIS AND PELVIC ABSCESS

See *Puerperal Endometritis* (p 2602) *Postabortal Endometritis* (p 2606), *Gonorrheal Salpingo oophoritis* (p 2608) *Tuberculous Salpingo oophoritis* (p 2610)

PELVIC THROMBOPHLEBITIS

See *Puerperal Endometritis* (p 2602), *Postabortal Endometritis* (p 2606)

PHLEGMASIA ALBA DOLENS

See *Puerperal Endometritis* (p 2602) *Postabortal Endometritis* (p 2606)

ACUTE MASTITIS

Acute inflammation of the female breast usually follows infection introduced through a fissure of the nipple in the course of nursing It may also be associated with the phenomenon of *caking* of the breasts during the first few days of lactation This latter condition is frequent and is characterized by *pain* and *tenderness* of the mammary tissue with some fever and leukocytosis The condition subsides without suppuration when the breast is supported by a tight binder and treated with cold compresses or ice bags

The onset of pyogenic infection is marked by an accentuation of the milder symptoms in the caked breast or the appearance of these manifestations in the woman who has an excoriation of the nipple Local pain swelling and tenderness are severe The temperature may rise as high as 104° to 105° F Chills are frequently encountered and a leukocytosis is demonstrable

Treatment —Postnatal mastitis may be prevented or minimized by the administration of synthetic estrogen in the form of diethylstilbestrol Following the birth of a non viable fetus in the event that the infant dies or if the parturient does not nurse the infant 10 mg of stilbestrol are given twenty four hours postpartum and 5 mg are prescribed thereafter four times a day for four days or until all evidence of congestion or mastitis has disappeared Only in rare instances is the drug not tolerated and in these cases androgen may be substituted in 10 mg doses given intramuscularly

Upon the first appearance of inflammatory change in the breast nursing is discontinued and *sulfonamides* or *penicillin* are administered prophylactically and curatively Despite adequate chemotherapy fluctuation is carefully sought since drainage is required if suppuration occurs In the latter event *radial incisions* are made outside of the areolar region in order to avoid division of larger ducts (p 3977) Through and through rubber covered *drains* are inserted to prevent stasis in the wound and spread of infection

CHRONIC CYSTIC MASTITIS

See *Benign Tumors of the Breast* (p 2580)

PAGET S DISEASE OF THE NIPPLE

See *Malignant Tumors of the Female Breast* (p 2581)

TUBERCULOUS MASTITIS

Tuberculous mastitis is a rare disturbance which is probably secondary to soft part invasion of the chest wall from an underlying pleuropulmonary process Tuberculous mastitis has the characteristics of a typical cold abscess a soft painless swelling is noted the tissue liquefies and forms a chronic granulomatous area with sinus tracts The etiological diagnosis becomes apparent only when the organism is demonstrated in smears or by biopsy Suspicion of the character of the disturbance is aroused by the appearance of the condition in a woman with known tuberculosis

Tuberculous mastitis is differentiated from a mammary cancer only by the histopathologist The *lesion* may require a local segmental removal of the section of the breast *With more extensive involvement a simple mastectomy* is considered

SYPHILIS OF THE BREAST AND NIPPLE

Primary secondary and tertiary syphilitic lesions may occur in the female breast

The *primary sore* appears as an indolent ulcer which may be regarded erroneously as a manifestation of Paget s disease of the nipple or a local malignancy If the condition is suspected *darkfield microscopy* (p 45) leaves no doubt as to the diagnosis In former days when wet nurses were employed chancre of the nipple occurred from the suckling of syphilitic babies

Secondary syphilitic lesions are seen on the breast as on other areas of the skin (p 3281) *Gummas* are rare manifestations Their presence is suggested by the occurrence of a non cancerous growth on the breast of a known syphilitic The final criterion is the response to the therapeutic administration of iodides

SECTION XVII

OBSTETRICS

Associate Editor ERIC MATSNER M D

CHAPTER 123

PREGNANCY

The Diagnosis of Early Pregnancy
The Physiology of Pregnancy
The Hygiene of Pregnancy

WHETHER or not the practitioner functions in his community as an obstetrician he is intimately concerned with problems incidental to pregnancy He is required to diagnose gravidity recognize normal changes that occur in the maternal organism care for the usual medical and surgical conditions that occur in the pregnant woman assay the effect of pregnancy on pre existent derangements guide the expectant mother in the hygiene of pregnancy recognize complications of pregnancy and placentation and assist in their prevention and early and adequate treatment

In many communities he is the obstetrician Elsewhere he cooperates with the specialist in the mechanics of parturition he assists in the management of the puerperium and lactation evaluates the significance of child bearing relative to major phenomena such as hypertensive cardio vascular renal disease urinary sepsis the endocrinopathies diseases of metabolism and the infectious states particularly syphilis tuberculosis and rheumatic fever He must be prepared to deal with the problems of the neonatal period and infancy so that he recognizes and often treats congenital defects metabolic disorders and prenatal congenital and acquired infections

THE DIAGNOSIS OF EARLY PREGNANCY

The diagnosis of early pregnancy rarely presents any difficulty if the condition is suspected Major surprises however are in store for the practitioner who does not regard each of his adult female patients with amenorrhea as potentially gravid

The two cardinal manifestations of early pregnancy are *amenorrhea* and the excretion of large amounts of *gonadotropic hormone in the urine* A number of other symptoms and signs have presumptive value

Amenorrhea —Each woman with amenorrhea is regarded as pregnant until the contrary is proved and no other diagnosis is considered until this possibility has been excluded Unmarried girls beget love children older women have change of life babies widows and the wives of absent sterile or impotent husbands may be impregnated by local or traveling Lotharios In any case to the realistic practitioner the missed period suggests pregnancy

In evaluating the diagnostic significance of amenorrhea it is important to realize that menstruation may continue after gestation and that pregnancy may occur in a woman who has never menstruated or in one who is amenorrheic for some other reason such as lactation tuberculosis or the menopause Persistence of amenorrhea despite three daily intramuscular

DIFFERENTIAL DIAGNOSIS OF

Oligomenorrhea, Hypomenorrhea, and Amenorrhea

Infrequent scant or absent menstruation is most often the result of a functional disturbance Between adolescence and the menopause amenorrhea is particularly suggestive of impregnation whatever the marital status of the woman

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Prepuberal Pregnancy with positive Friedman test (p 2496) Postpartum but exclude pregnancy Menopausal but exclude pregnancy
Psychogenic	Anxiety fear and prolonged nervous strain Exclude pregnancy by Friedman test (p 2496)
Pharmacodynamic	From intensive androgen therapy (p. 2406)
Congenital Malformation	Imperforate hymen with hematocolpos (p 2529) Cervical stricture or stenosis (p 2535) Aplasia or hypoplasia of internal genitals (p 2534) Confirm local findings with consultant gynecologist
Gynecologic	Cervical stenosis with hematometra (p 2535) Following hysterectomy bilateral oophorectomy or irradiation of the ovaries Destruction or atrophy of ovaries resulting from gonorrheal or tuberculous salpingo oophoritis mumps oophoritis or syphilis Destruction or atrophy of uterine mucosa due to endometritis (p 2607) or repeated abortions
Neoplastic	Follicular or corpus luteum cysts of the ovaries (p 2566) Arrhenoblastomas (p 2575) Investigate tumor at laparotomy
Systemic Infections	Mumps with parotitis of recent or remote origin Syphilis with positive serology Tuberculosis with identification of acid fast bacillus in secretions or histologic evidence at biopsy Gonorrhea with identification of gram negative diplococcus or positive complement fixation test
Endocrinopathies	Hypothyroidism with low B M R. and therapeutic response to thyroid extract Severe hyperthyroidism with elevated B M R. and therapeutic response to iodides and Deracil (p 1197) Hypopituitarism and dyspituitarism (p 1166) X ray sella turcica and confirm neurologic findings with consultant neurosurgeon Diabetes mellitus with hyperglycemia and glycosuria (p 1246) Adrenal cortical tumors with masculinization and increased androgen excretion in the urine (p 1278) Primary hypogonadism with delay in onset of menarche and diminished or absent estrogen in urine but normal or increased gonadotropin

injections of *neostigmine* (p 2511) is particularly suggestive evidence of pregnancy

Pregnancy Tests —When pregnancy is suspected a biologic assay of the urine for gonadotropic hormone is performed (Aschheim Zondek or Friedman test p 2496) These tests approach 99 per cent accuracy in the diag

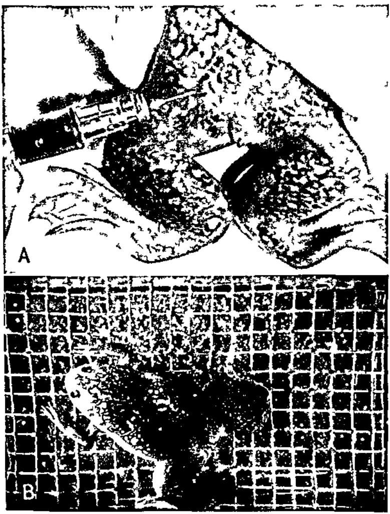


Fig 661—Frog (*Xenopus laevis*) test for early pregnancy *A* Position of needle during injection of 1 cc of urine concentrate equivalent to 40 cc of whole urine *B* Positive reaction Note numerous extruded eggs This may occur from four to eighteen hours after injection

nosis of early pregnancy Usually the test is positive within one week after the first missed period and remains so for about six days after delivery or for as long as there is living chorionic tissue in the body Rare errors include *false negatives* when the test is performed too early in pregnancy and *false positive tests* associated with conditions other than pregnancy

Courtesy of Dr A I Weisman From Hoffman Female Endocrinology

such as *hydatidiform moles* (p 2654) *chorionepitheliomas* (p 2655) *teratomas* of the ovaries or testes (p 2572) and the retention of viable placental tissue after delivery or abortion

Clinical Manifestations—In addition to amenorrhea and a positive pregnancy test early gravidity is commonly attended by morning sickness characterized by *nausea* and *vomiting* This annoyance is present in 50 to 60 per cent of women particularly those who are highstrung and of a nervous temperament In rare instances there may be intractable vomiting (p 2637) leading to a dangerous degree of dehydration As a rule morning sickness appears about two weeks after the first missed period and increases in intensity for about one month By the end of the third month it is usually less troublesome and often disappears entirely although it may persist throughout pregnancy

Despite the fact that morning sickness is most likely a biochemical phenomenon there is a tremendous psychogenic overplay It is certainly more frequent in primipara and occurs often in its most violent forms in women who are displeased with impregnation or at odds with the marital partner The symptoms occur more often in women of wealth and leisure than those who must work for a living

Other symptoms encountered during the first months of pregnancy include hypersalivation persistent belching an increase in appetite a craving for unusual foods, fatigue frequency of urination due to pelvic engorgement or relaxation of the vesical sphincter and pressure of the enlarging uterus on the bladder tingling and a feeling of fullness in the breasts and changes in mood Some women are buoyed by the gravid state and relate that they never felt better whereas others are depressed and morose

Physical Signs of Early Pregnancy—The physical signs of early pregnancy are chiefly pelvic and of themselves are not diagnostic When viewed in conjunction with the rest of the clinical picture they indicate strongly the possibility of pregnancy At about the sixth week softening of the cervix may be apparent (*Goodell s sign*) as well as an irregular softening of the body of the uterus *intermittent uterine contractions* may be noted by a keen observer during bimanual examination (*Braxton Hicks sign*) inspection of the cervix and vaginal mucosa disclose a purplish *cyanosis* due to increased vascularity of the tissues (*Chadwick s sign*) Between the sixth and eighth weeks the isthmus of the uterus becomes soft and compressible on bimanual examination (*Hegar s sign*) and the cervix may be moved without a corresponding movement of the fundus the breasts enlarge and there is increased erectility of the nipples Enlargement of the mammary veins and pigmentation of the areolas occur toward the end of the third month at which time a thin colostrum may be expressed from the nipples

THE PHYSIOLOGY OF PREGNANCY

Pregnancy produces fundamental changes in the maternal organism affecting almost every system in the body A knowledge of these phenomena is important in the management of normal gestation and in the proper evaluation of the medical complications of pregnancy

The Reproductive System—During pregnancy the *uterus* undergoes a

remarkable increase in size from 7x5x5 25 cm to 35x25x22 cm and it augments its capacity several hundredfold The enlargement occurs gradually from month to month and is a reliable measure of the duration of gestation

For the *first two months* of pregnancy the uterus is below the pubic rim and the fundus is palpable through the anterior fornix By the *third*

DIFFERENTIAL DIAGNOSIS OF

Swellings and Tumors in the Hypogastrium

The wary practitioner initiates his investigation of a swelling or tumor in the hypogastric region by catheterizing the urinary bladder lest he be misled by a mere retention of urine (p 2264) Should the tumor persist, after emptying of the bladder suspicion shift to an organic lesion of the lower end of the digestive tract or of the reproductive organs

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Gynecologic	Pregnancy Confirm by Friedman test (p 2496) Subinvolution or retention of products of conception Note response to oxytocics and prepare for curettage if necessary Hydatidiform mole or chorionepithelioma (p 2655) Get curettings Uterine fibroids or cancer Get curettings Ovarian cysts or neoplasms (p 2568) Prepare for laparotomy Hydrosalpinx or pyosalpinx (p 2608) Note mass in fornix and prepare for laparotomy Ectopic pregnancy with positive pregnancy test and mass in fornix (p 2657)
Reproductive (Male)	Malignancy of prostate (p 2449)
Urinary	Retention of urine (p 2264) confirmed by catheterization (p 2236) Order cystoscopy and urography (p 2251)
Urachal	Congenital cysts (p 2287) Confirm by laparotomy
Renal	Ectopic kidney Get intravenous urogram (p 2251)
Intestinal	Impaction of feces Inflammation or neoplasm involving sigmoid or rectum (p 1917) Attempt visualization by sigmoidoscopy or barium enema Consider exploration
Peritoneal	Hematocele especially after rupture of ectopic pregnancy (p 2658) Pelvic abscess after acute appendicitis gonorrheal or tuberculous peritonitis (p 1927) Prepare for exploration

month the fundus has risen so that it is halfway to the navel At the *fifth month* the uterus begins again to assume an elliptical form since it is enlarging in the direction of the fundus At the sixth month its upper level reaches the umbilicus and it then rises one fourth the way to the ensiform cartilage each month until the ninth At this time the uterus sinks downward and forward This process of *lightening* proceeds until the upper level recedes to the eighth month mark

The increase in uterine size is associated with softening of the muscular wall changes in position and a tendency to *dextroversion* and *torsion toward the right* These physical alterations serve to kink or compress the *right ureter* and may be a predisposing cause of the *pyelitis of pregnancy* (p 2644) which is almost always right sided

At term the uterus weighs more than 1000 gm in contrast to the 60 gm weight of the nongravid organ Hypertrophy and hyperplasia of the muscle and connective tissue and a general increase in vascularity are noted

During the first three months of pregnancy the *cervical canal* points forward and upward When the uterus rises higher in the abdomen the

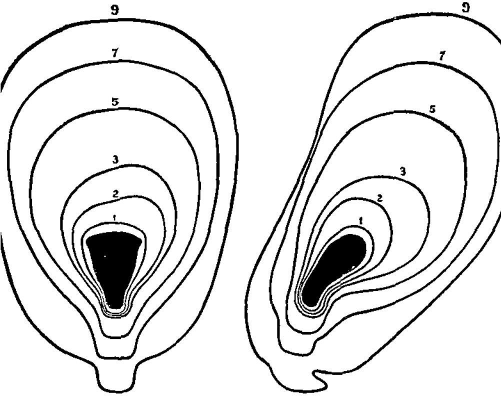


Fig 66* —Uterus at successive months A Front view B Side view

cervix takes a more vertical direction and begins to soften until in the seventh month its outlines are difficult to distinguish The external os dilates and may admit one finger Just before labor commences the mucus plug is expelled as the show and dilatation of the cervix progresses until it is possible for the presenting part to pass through

The *vaginal wall* takes on a purplish color due to increased vascularity the mucosa thickens and becomes rough and the canal is more elastic and distensible the *fallopian tubes* are elongated and come to lie parallel to the long axis of the uterus the *ovaries* are enlarged and tender and

* DeLee and Greenhill Principles and Practice of Obstetrics 8th Ed.

occupy a position lateral to the uterus The *corpus luteum* reaches its maximum development during the first three months and begins to regress toward the middle of the third trimester *Uterine and ovarian blood vessels* are large elongated and more tortuous they are responsible for the production of the *uterine souffle* a soft hum heard over the large vessels on one or both sides of the uterus after the sixteenth week

The Abdominal Wall—The growth of the uterus is attended by progressive enlargement of the *abdomen* and distention of the *abdominal wall* After the sixth month the *umbilicus* usually protrudes the *linea nigra* a narrow line of pigment extends from the umbilicus to the pubic symphysis increase in intra abdominal tension produced by the gravid uterus puts a marked strain on the abdominal skin and causes its elastic tissues to tear with the production of *purplish striae* (p 2631)

The Breasts—Soon after the occurrence of pregnancy the breasts appear enlarged sensitive and nodular The mammary glands become hypertrophied and hyperplastic and there is an increase in the amount of *mammary fat* The *primary areola* is deeply pigmented during the second month and shows many coarse enlarged *sebaceous glands* *Colostrum* may be expressed by the third month and a *secondary pigmented areola* is usually present by the sixth month There is a noticeable enlargement of the mammary veins Striae similar to those seen on the abdominal wall develop at the periphery of the breasts in about 60 per cent of women The onset of lactation occurs 24 to 36 hours after delivery

The Osseous System—During pregnancy the skeleton is the chief source of *calcium* and *phosphorus* required for fetal growth In early pregnancy these minerals are stored in the bones and are given up to the fetus, as the demand progressively increases Unless the dietary intake of bone forming minerals is sufficient to establish this reserve the bones tend to become *demineralized* There is usually an increase in the extent of the bone marrow associated with relaxation of the pelvic joints and an increase in the size of certain bones particularly those of the pelvis *Puerperal osteophytes* on the inner surface of the skull are present in about one third of pregnant women

The Hematopoietic System—The pregnant woman often reveals a physiological decrease in the hemoglobin concentration and in the red blood count *Hemoglobin values* of 10 to 12 gm per cent are not uncommon Some of the anemia is due to a slight *hemodilution* which is a normal occurrence However pregnancy often exerts an appreciable strain on the hematopoietic system and true *anemias* are not infrequent The *leukocyte count* remains unchanged until the last trimester and during labor when *leukocytosis* and *polynucleosis* up to 15 000 to 20 000 WBC per cubic millimeter may be encountered *thrombocytes* tend to increase up to 500 000 per cubic millimeter The leukocytosis and thrombocytosis of late pregnancy are probably due to increased activity of the bone marrow The *erythrocyte sedimentation rate* is moderately accelerated especially during labor and does not return to normal for about a month postpartum

The Cardiovascular System—A slight degree of *cardiac hypertrophy* is believed to occur in most gravid women The cardiac apex usually is displaced upward and outward by the high diaphragm In the fourth month the *cardiac output* begins to increase and at term it is about 50 per cent

above normal *Murmurs* frequently appear and are hemic in origin or due to cardiac displacement

As a rule *blood pressure* is slightly lower than in the non pregnant state *Any rise in blood pressure above the pregravid level (p 3487)* is viewed with some concern since it may herald the onset of *hypertensive toxemia* (p 2638), a normal rise in blood pressure occurs during labor

Increase in intra abdominal pressure and pressure of the enlarged uterus produce a stasis of blood in the pelvis and lower extremities so that one third of pregnant women develop *varicosities* of the legs vulva or vagina and *hemorrhoids* There may be also a mild degree of *leg edema*

The Respiratory System —During the latter half of gestation the descent of the diaphragm is limited by the upward pressure of the enlarging uterus Respiration is predominantly costal and more rapid At times this approaches *hyperventilation* and may lead to *alkalosis* (p 722) Restriction of respiratory mechanics is attended by a tendency to shortness of breath and decrease in *vital capacity* (p 3739) The mucous membranes of the *entire upper respiratory tract often are congested*

The Digestive System —In many women early pregnancy is heralded by *nausea* and *vomiting* as previously discussed In addition there are inexplicable perhaps teleological changes in *appetite* and increase in *salivation* The gastric mucosa is congested and there is hypersecretion of gastric juice of low acid content so that the administration of dilute hydrochloric acid is often most gratifying

The *cholesterol content* of the bile is increased and pure *cholesterol stones* may form in the gallbladder (p 1997) suggesting the wisdom of the low fat diet (p 674) As a result of uterine pressure *gastric distress and constipation are not uncommon during the latter months* The *appendix* is displaced upward and is above the level of the iliac crest after the sixth month producing diagnostic difficulties when an acute inflammation occurs during gestation

The Urinary System —During the early months *frequency of urination* is common due in large extent to uterine pressure since it subsides when the uterus rises out of the pelvis At the end of pregnancy, there is a return of frequency as a result of the descent of the uterus (lightening) and pressure of the fetal head

The work of the kidneys is increased by the added metabolic burden of the growing fetus The volume of *urine is somewhat augmented* but as a rule there is no limitation of concentrating power The urine is normally free of albumin and dextrose but 10 to 15 per cent of women develop *renal glycosuria* of pregnancy (p 1262) during the later months *Lactosuria* (p 3677) is encountered during the nursing period

At about the fifth month *dilatation of the ureters* occurs more marked on the right This is associated with dilatation of the renal pelvis which may be doubled *in capacity The changes in the upper right urinary tract* are conventionally attributed to the *dextroversion* and *right sided torsion* of the uterus but progesterone induces a similar ureteral dilation in experimental animals The dilatation of the urinary passages favors the onset of the *pyelonephritis of pregnancy* (p 2644)

The Nervous System —The neuropsychiatric manifestations of pregnancy are confined to changes in the *psyche* Some women resent pregnancy and

go to extremes in their efforts to produce an abortion they become surly and depressed psychopathic trends become exaggerated and may precipitate a *psychosis* (p 2647) We are among those who doubt the existence of the pregnancy psychoses in the sense that the disturbance develops wholly on the basis of the gravidity Most women happily rejoice when *they impregnate and experience a sense of well being and a spiritual* exaltation

Organic neurological manifestations of pregnancy are rare and usually secondary The ancient pregnancy neuritis was likely an *avitaminosis* (p 616) in those with persistent emesis the *sciaticas* (p 3072) are mechanical in origin and require proper corseting and instructions as to posture (p 3492)

The Tegumentary System —Changes in the skin and its appendages during pregnancy are largely endocrinological and nutritional Pigmentations of face (*chloasma gravidarum*) linea nigra breasts and nipples attest to *anterior pituitary changes* which also account for *acromegaloid* characteristics *Alopecia* and *nail dyscrasias* are nutritional or psychogenic The dermatoses of pregnancy are elsewhere discussed (p 2648)

The Endocrine Glands —Most of the endocrine glands undergo hypertrophy or hyperplasia and show evidences of increased function during pregnancy Many of the complications and sequels of pregnancy may originate in the glandular upheaval that takes place

Anterior Pituitary Gland—The anterior pituitary gland increases in size and there is histologic evidence of increased activity of acidophile and basophile elements A so called *pregnancy cell* which is large clear and poorly staining appears as a phase of the secretory cycle of the acidophile cells The vascularity of the gland is markedly increased Rarely pressure on the optic chiasm causes a temporary *hemianopsia* which disappears after delivery *Postpartum necrosis of the anterior lobe is a common cause* of *Simmonds disease* (p 1169) Although removal of the hypophysis results in a termination of pregnancy in experimental animals anterior lobe insufficiency is not incompatible with a successful human gravidity and may be made less severe by the episode

Thyroid Gland—Enlargement of the thyroid gland is frequently observed in pregnant women There is *hyperplasia* of parenchymal cells increase in the blood supply of the gland and often an increase in stored colloid There is a slight increase in the *basal metabolic rate* as pregnancy progresses In some women the thyroid enlargement is due to an absolute or relative *iodine* deficiency and is prevented by iodine administra*tion* (p 1213)

Parathyroid Glands—The parathyroid glands are enlarged during the latter months of pregnancy and there is some evidence of increased function at this time The physiologic *hyperparathyroidism* of pregnancy (p 2674) has been viewed as a compensatory phenomenon to prevent undue lowering of blood calcium and to facilitate the transfer of minerals from mother to fetus

Adrenal Cortex—There is some hypertrophy of the adrenal cortex during gravidity There is no evidence of increased cortical function however as measured by available methods It is interesting to note that pregnancy increases the survival time of adrenalectomized animals

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endocrine glands which occur during pregnancy are associated with fundamental metabolic alterations In many women there is a moderate reduction in *carbohydrate tolerance* which may be related to physiologic changes in hormonal equilibrium *glycosuria* is easily provoked and *diabetes mellitus* (p 1246) may occur

A positive *nitrogen balance* is maintained soon after the onset of gravidity The quantity of stored protein is in excess of the needs of the fetus especially during the early months and is designated as *reserve protein* After delivery the nitrogen balance becomes negative due to involution of the uterus and the large loss of protein from *lactation*

There is a tendency to store *fat* and to an increased utilization of fat for energy This is associated with *lipemia* and *hypercholesteremia* The development of *ketosis* is easily provoked by withdrawal of dietary carbohydrate

The pregnant woman stores *calcium* and *phosphorus* during the early months There is a steady rise in the fetal absorption of calcium from 50 mg a day at three months to 450 mg a day during the tenth lunar month During normal pregnancy provided the diet is adequate maternal retention of calcium exceeds the daily fetal requirements At the tenth lunar month when the fetal need is almost double calcium must be withdrawn from maternal reserves An excessive depletion of the maternal reserve leads to *osteoporosis* and *osteomalacia* (p 2803) *Lactation* is attended by a markedly negative calcium and phosphorus balance In addition to the loss of these minerals in the milk there is an excessive excretion in feces and urine

The *basal metabolic rate* is unaltered during the first trimester but rises as pregnancy progresses to reach readings of +30 per cent at term This increase is often maintained during *lactation* The increase is attributed to the metabolism of the fetus and to the altered function of the endocrines

The *body weight* is usually unchanged during the first three months In individuals with marked nausea and frequent vomiting there may be an appreciable weight loss Beginning with the fourth month a progressive increase in weight is almost invariable The average total gain is 20 to 25 pounds more than half of which occurs in the last four months In accounting for the weight gain the child is estimated at seven pounds the placenta at 1½ pounds amniotic fluid at 1½ pounds the uterus at 2 pounds and breasts enlargement blood and retained fluid at 3 pounds The remainder is largely stored fat An excessive gain in weight is associated with overgrowth of the fetus and at times with fluid retention

Blood Chemical Changes —The concentrations of most chemical constituents of the blood are slightly altered as a result of changes in metabolism There is a decrease in *plasma albumin* and in total *plasma protein* These change are related to some impairment in the ability to synthesize protein in addition to the fetal demand for *amino acids* they require that the pregnant woman be provided with a diet rich in proteins of high biologic value

There is no appreciable change in the concentration of *plasma globulin* but there is a moderate rise in *plasma fibrinogen* The changes in protein metabolism are reflected also by decrease in total *nonprotein nitrogen* con

Corpus Luteum—The corpus luteum maintains a secretory endometrium and inhibits uterine motility during the early months by means of *progesterone* (p 2517) Subsequently after the fourth month, the ovarian source is supplemented by the *placenta* Removal of the corpus luteum before the fourth month causes *abortion* (p 2649) and administration of the extract is useful in preventing uterine emptying After the placenta has assumed its progestational function, the activity and significance of the corpus luteum terminates

Placenta—The placenta in addition to its function as an organ facilitating the exchange of metabolic products between fetal and maternal circulations is an important *endocrine gland* It elaborates a *gonadotropic factor* whose presence is the basis for the biologic tests for pregnancy (p 2619) After the fourth month of gestation it is the principal source of *progesterone* (p 2517) The role of chorionic gonadotropin is not known but it may be concerned with the action of estrogen and progesterone in some manner at present undetermined Some of the disorders of pregnancy may be related to the abnormal production of the hormone (p 2638)

Hormone Assays During Pregnancy—Significant and striking alterations in assays of estrogen pregnandiol and chorionic gonadotropin occur in pregnancy and may have important bearing on the otherwise inexplicable problems of *spontaneous abortion* (p 2650) and the *toxemias* (p 2638)

Estrogen—During the first trimester there is a slow increase in the *estrogen* content of blood and urine At twelve weeks the level is higher than is likely to be encountered in any other condition The rise continues until the highest peak is attained at or near the onset of labor Decreases in urinary and blood estrogen are seen in the latter part of pregnancy in some patients with toxemia

Pregnandiol—The urinary output of pregnandiol the excretory end product of progesterone metabolism increases only slightly from the normal nongravid level of 3 to 6 mg per day until about the twelfth week At this time it begins a steady rise with a peak at term of 60 to 100 mg daily The excretion rate begins to fall before the onset of labor and reaches low levels after the delivery of the placenta In some patients there is a drop in pregnandiol excretion during the third month possibly as a result of premature failure of the corpus luteum or inadequate placental secretion This is associated with *spontaneous abortion* and is the basis for the use of progesterone in *threatened* and *habitual abortion* (p 2518)

Chorionic Gonadotropin—An increase in chorionic gonadotropins is detected in the blood and urine about ten days after fertilization Within a week after the first missed period sufficient hormone is present in the urine to give a positive *pregnancy test* (p 2619) The concentration rises rapidly to very high values between the sixth and sixteenth weeks At the beginning of the fifth month hormone concentration falls and thereafter remains fairly constant After the delivery of the placenta gonadotropin values fall rapidly and usually reach normal nonpregnant values within a week An increased excretion persists if viable placental fragments have been retained A disturbance of the *estrogen chorionic gonadotropin ratio* may be related to the occurrence of *toxemia of pregnancy*

Alterations in Metabolism—Changes in the structures and functions of

n e and *condition* of each child at birth The birth of a normal sized child without difficulty is reasonable proof of an ample pelvis The untoward effects of previous pregnancies (vomiting headache hemorrhage visual disturbances edema or convulsions) are established accurately with particular regard to the present pregnancy The date of the last menstrual period is noted for use in estimating the date of childbirth (p 2634)

Physical Examination —The pregnant woman is given a complete physical examination (p 3478) A gentle *vaginal examination* is made to confirm the diagnosis of pregnancy and to determine malposition of the uterus the existence of a uterine or cervical fibroid or ovarian cyst or tumor *Blood pressure* is noted and the *urine* is examined for albumin sugar and formed elements Many states require *serologic tests for syphilis* A routine *hemogram* is made and the *weight* is recorded A *dental consultation* is arranged for prenatal care The details regarding hospitalization and obstetrical care at the time of parturition are also discussed and settled

Prenatal Visits —Return visits are planned every month during the first six months and every two weeks thereafter until the final month when the patient is seen once each week At each visit the expectant mother is weighed her blood pressure taken and her urine examined The abdomen is palpated to estimate the progress of pregnancy An inquiry is made relative to the presence of unusual symptoms or signs Frequent hemoglobin determinations are advisable

Untoward Symptoms —The patient is instructed to communicate with the physician at once upon the development of *excessive vomiting vaginal bleeding persistent headache edema* as evidenced by tightness of shoes or rings *visual disturbances* a *gush of water* from the vagina sudden *pain* in the lower abdomen or pelvis and *gain in weight* exceeding 2 pounds in a week Total weight gain during pregnancy should not exceed 16 to 20 lbs

Diet —One of the best safeguards of maternal health and normal fetal development is the maintenance of a good state of nutrition Most of the fetal requirements are satisfied but at the expense of the maternal organism if the diet is not adequate for the needs of both Many gravid women tend to overeat as an unconscious effort to counteract the errors of faulty selection Others suffer nutritional disturbances through morning sickness ignorance or poverty

Normal Requirements —Special diets are unnecessary if the patient daily intake includes a quart of milk two portions of green vegetables rich in vitamins A and B two oranges 1 grapefruit or two tomatoes rich in vitamin C one portion of a rich source of iron (eggs red meats or liver) adequate roughage (cereals and whole wheat bread rich in vitamin B) and 6 to 8 glasses of water Salt is used sparingly

Special Diets —Certain dietary regimens are suited to various stages of gestation During the *first trimester* a diet rich in carbohydrate (p 672) is preferred by many women especially if morning sickness is a problem Frequent small feedings of potatoes bread rice sugar candy dates and figs are often useful in preventing the recurrence of nausea As soon as the nausea subsides excessive carbohydrate is eliminated to prevent undue weight gain During the third trimester the weight is watched carefully and the diet adjusted to prevent excessive gain A total gain in weight of 16 to 20 lbs is permissible

centrations and *urea nitrogen* of plasma The *blood uric acid* does not share in this decline but may even increase

Plasma cholesterol usually rises about 30 per cent with maximum values at the seventh month The increase is chiefly in the free fraction and may have a bearing on the relationship between pregnancy and *cholelithiasis* (p 1997) Normal values are restored about two months after delivery There is a parallel increase in *neutral fat fatty acid* and *phospholipid* contents of the plasma

The *fasting blood sugar* usually remains within normal limits However at about the sixth month some women manifest a definite decrease in *glucose* tolerance and a frank *diabetes mellitus* may be precipitated (p 1246) By contrast, some diabetics exhibit an increase in glucose tolerance during the latter half of gestation possibly an effect of fetal insulin

Changes in Basal Temperature—The menstrual cycle of women of child bearing age is attended by a characteristic diphasic temperature curve if readings are taken rectally on awakening in the morning The *premenstrual phase* the period of high temperature is initiated at ovulation the temperature rising 0 4 to 0.8 F The *postmenstrual phase* which covers the span from the onset of menstruation up to the period of ovulation is at the lower level The *low to high temperature shift* is approximately 14 days prior to the onset of menstruation and indicates probable ovulation A *monophasic temperature* pattern suggests that the woman is not ovulating and hence is infertile A *diphasic curve* indicates that the woman has ovulated If the premenstrual elevation is followed by the normal postmenstrual fall the woman has ovulated but not impregnated On the other hand *if the premenstrual elevation persists for 16 days or more she has both ovulated and impregnated* Thus the test may be used as an index of ovarian function a pregnancy test, a guide to the fertile and safe periods and as proof of therapeutic effects when potent endocrine therapy is given

Changes in Fetus (Quickening)—Active fetal movements (quickening) may be felt by the patient or physician as early as the twelfth week but more often these signs are not registered until the fourth or fifth month Just beyond the halfway mark in the fifth month of gestation fetal heart sounds become audible at a rate of 120 to 160 per minute A later circulatory phenomenon due to the fetal blood vascular system is the audibility of the *fetal souffle*

THE HYGIENE OF PREGNANCY

Antepartum care is a potent factor in the reduction of fetal and maternal mortality and morbidity Preventive medicine can be served in no greater capacity than in the meticulous ministrations of the physician to the pregnant women for her sake and in the interest of her fetus

Ideally the routine management of pregnancy begins as soon as the first period is missed The history and physical examination mark out zones of danger which require particular attention The conduct of the way of life (p 3473) is reviewed in relation to the altered situation

History—A careful history is of great help in the management of pregnancy The patient who has ever had rickets rheumatic fever scarlet fever tuberculosis syphilis gonorrhea hypertension cardiorenal manifestations or any other serious disease may require special attention with regard (1) to the possible effects of the gravidity on the pre existent condition and (2) to the influence of the pre existent condition on gestation and parturition A knowledge of *previous surgical operations* may be a guide to possible obstetrical difficulties *Antecedent labors* are carefully evaluated to determine the *character* and *length* of each labor and the

End of 3d lu a month	O u i s tle s e of a tennis ball Fetus is 7–9 cm long weighs 30 gm C nters of oss fcation of fn gers toes sp ie are formed Nails ar present	Uterus n ea ures 13 x 10 x 7.5 cm It is ovo d and can be f lt abo e the pelvic b im Cavity is almost obl terate l	Morning s kness and bladder i ritab lity are al ost gone	Brea ts are large and p g me t d Colostrum can be expressed Uterine souffle can be heard	
End of 5th lunar month	Fetus is 18–27 cm long Weight 280 gm Body is covered with vern x caseosa External gen tal a are dif ferentiated Eyelids are open	Uterus meas ires 18 x 15 x 12 cm and is still more ovoid Internal ballottement is possible	Mu cle cramps may be presei t due to calcium deficiency Fetal move ments (life) are felt	Breasts sho a secon dary areola Fetal heart beat Fetal shock Uterine souffle Chlo asma gravidarum	
End of 6th month	Fetus is 31 cm long Weighs 6 0 gm May live if born	Uterus measures 21 x 16 x 15 cm and extends to level of umbilicu Left border is more anterior Un equal uterine souffle may be heard		Linea nigra Fetal parts d scernible Striae grav idarum begin to form	
End of 7th month	Fetus is 36 cm long Weighs 1200 gm	Uterus measures 26 x 18 x 16 cm Three fingers above umb l cus		Striae gravidarum fun c souffle	
End of 8th month	Fetus is 40 cm long Weighs 1600 m	Uterus almo t reaches en fo m p c ess of stern im Mea ures 9 x 1 x 17 cm	P es ure sy n ptoms com mence dyspnea con t pat on g stric dis comfort	Varicose ve ns ankle edema protru ling um b l cus	
End of 9th month	Fetus is 44 cm long Weighs 2500 gm	Uterus reache ensiform Measures 33 x 23 x 21 cm	Pressure sym ptoms pres ent	Striae increase	
End of 10th month	Fetus is 50 cm long Weighs 3900 gm		On et of labor		

Table 141 —The Progress of Mother and Fetus During Pregnancy

	Embryo (ovum)	Uterus and Ovaries	Symptoms	Signs	Tests
End of 1st lunar *month*	Embryo has been implanted for one week and is about 16 days old *Measures* 2-3 mm Three germ layers are present Amnion and yolk sac are formed	Somewhat enlarged and softened Endometrium has developed *into* decidua vera Corpus luteum continues to grow	Amenorrhea	Bimanual examination negative	A Z test positive
End of 6th week	Embryo is 1 cm long Anlage of *heart brain* limbs oral fossa ears nasal fossae are present Amnion is large and there is a body stalk which contains the allantois remnant of yolk sac and chorionic vessels Fetal and maternal circulations have come into contact and fetal heart has begun to beat	Enlargement of uterus continues Shape is more ovoid Entire uterus is soft particularly the cervix whose hyperactive glands produce a white discharge Normal anteflexion is increased Ovum bulges from uterine wall and is covered by decidua capularis	*Morning sickness* Frequency of urination Painful turgid breasts	*Bimanual* inspection reveals uterine enlargement with softening and rounding of the body Intermittent uterine contractions may be felt Vaginal wall cyanotic Breasts enlarged	
End of 2d lunar month	Ovum is 6 weeks old the size of a small hen s egg (5 x 3 cm) Embryo is 2.5 cm Limbs are well developed External genitalia have appeared Form is adult and term fetus is applied Amnion has fused with the inner layer of chorion and the chorion laeve and frondosum are well differentiated	Enlargement of uterus continues Measures *10* x *6* cm *Almost* ovoid The body is softer Isthmus is compressible (Hegar s sign) In *intermittent* contractions of uterine muscles can be felt Cervix is softer more vascular and its glands are enlarged and tortuous Mucous plug is formed	Morning sickness Ptyalism *Urinary* frequency Emotional instability Slight constipation	Hegar s Goodell s Chadwick s Braxton Hicks Breasts are large and pigmented Nipples erect and pigmented	Acetonuria

cut down on the amounts of *sedatives* *narcotics* and *opiates* Infection may be treated safely with *sulfonamide* and *penicillin* Heroic therapeutic devices such as the intensive treatment of *syphilis* (p 344) apparently have no deleterious effect on fetal tissue

The Bowels—*Constipation* is common in gravid women as a result of the pressure of the enlarging uterus and the tendency to a sedentary life It leads to annoying abdominal discomfort and should be avoided if possible by the development of regular bowel habits A leisurely evacuation *is attempted after breakfast The diet should contain adequate roughage* and plenty of fluids An *enema* of a pint of warm soapsuds is satisfactory as an occasional measure *Mineral oil milk of magnesia* or *citrate of magnesia* may be necessary to secure a daily bowel movement during the last trimester *Castor oil* is avoided under any circumstances The use of a footstool placed in front of the toilet is recommended as a means of improving posture during defecation

The Kidneys—Efforts are made to guard against possible renal damage Foci of infection in teeth and tonsils are removed early in the gestational period sufficient fluid is ingested to maintain a daily output of 1500 to 1800 cc The urine is examined at each return visit The patient is instructed *to report any sudden reduction in urine output the appearance* of edema or rapid gain in weight Any febrile episode is regarded as a possible concomitant of *pyelonephritis* of pregnancy (p 2644)

The Breasts—The enlarging breasts are supported without compression by a good brassiere The nipples are washed daily with soap and water After the fifth month they are treated nightly with an inunction of cocoa butter or olive oil This serves to soften the skin and prevents fissures during nursing Small inverted nipples are subjected to gentle outward traction each time the emollient is used

Exercise and Rest—In general a pregnant woman is urged to continue her daily life with little change The woman in industry may continue her occupation until the last few weeks or months Substituting an idle life for a busy one is a grave mistake but it is equally fallacious to overexert and produce undue fatigue Eight hours of sleep in a well ventilated room are desirable Light sports such as golf dancing and swimming are permissible *during the first two trimesters The daily shower or bath is a necessity*

The average woman does well to rest at the time of her expected menstrual period during the first four months since abortion is most apt to occur at these times During the later months excessive exertion is *avoided The questions of exercise and rest are largely individual problems*

Clothing—The pregnant woman is requested to wear comfortable attractive clothing There is no need for slovenliness and carelessness Maternity clothes are available which enable the expectant mother to dress according to prevailing style and at the same time to respect the demands of pregnancy

Constricting bands about the waist and pressure on the breasts and nipples are avoided As a rule some form of *abdominal support* is needed Many women find that an old girdle whose elasticity has diminished through wear is conducive of greater comfort After the fifth month however a feeling of weight and discomfort in the back and lower abdomen is an indication that a good carefully adjusted *maternity corset* is neces

The requirements during pregnancy may be summarized as follows

Total Calories (for a woman weighing 123 pounds)	2500
Protein	85 gm
Calcium	1.5 gm
Iron	15 mg
Vitamin A	6000 I U
Thiamine	1.8 mg
Riboflavin	2.5 mg
Nicotinic Acid	18 mg
Ascorbic Acid	100 mg
Vitamin D	400–800 I U

The diet during lactation will not differ appreciably from the diet in the latter months of pregnancy It is important to maintain a relatively high *protein* intake approximately 100 to 125 gm daily This is best obtained from milk eggs and the meat products The *minerals* particularly *calcium* and the *vitamins* must be supplied exactly as during pregnancy

The dietary should contain (for a moderately active woman weighing 123 pounds)

Total Calories	3000
Protein	100 gm
Calcium	2 gm
Iron	12–15 mg
Vitamin A	8000 I U
Thiamine	2.3 mg
Riboflavin	3.0 mg
Nicotinic Acid	23 mg
Ascorbic Acid	150 mg
Vitamin D	400–800 I U

Accessories to the Diet—A variety of accessory metabolic substances may well be added to the diet whether or not indications exist Women who are taking an insufficient amount of milk or evidence manifestations of calcium deficiency are given one of the chocolate coated or mint flavored preparations of the *lime salts* (p 604) Those who crave acid foods or complain of anorexia are often helped by the administration of *Dilute Hydrochloric Acid* U.S P or the more palatable capsules of *Acidulin* (p 1048) The *multivitamin products* and those which assure the daily supply of *minerals* are prescribed after the third month In goiter belts and for women who have thyroid enlargement small doses of *sodium iodide* (p 1219) are prescribed daily provided symptoms of iodism do not become apparent The frequent presence of anemia of pregnancy indicates the wisdom of giving supplementary amounts of a simple *iron salt* (p 1048) after the fifth month

Alcohol and Tobacco—There is no need to change *alcohol* and *tobacco* habits of the mother Excessive use of either of these substances is discouraged but there would seem to be no harm in an occasional cocktail the continued use of wine with meals and ten cigarettes daily Many pregnant women sleep better if they take beer or ale at bedtime

Drugs—Though not a great deal of information is available concerning the effects on the fetus of drugs given to the mother it is wise to

sary *Circular garters* are avoided Low or medium heeled well fitting ***shoes*** are desirable Good support of the long arch is important (p 3078)

Sexual Intercourse —During the first seven months sexual intercourse is permissible except at the time of the expected menstrual period during the first three months Intercourse is avoided after the seventh month since there is evidence that it increases the incidence of *puerperal infection* (p 2603) Douching is forbidden unless specifically ordered by the physician

Psyche —Psychotherapy is of tremendous value particularly in first pregnancies Many young women are panic stricken by old wives tales and the fear of the pains of labor They must be encouraged to regard pregnancy as a relatively physiological process They are instructed to carry out their daily routine and their habits of life without modification until they get in their own way

Quite as difficult a problem as the fearful matron is the woman who regards pregnancy as her life work and who following conception leads a mollusk like existence rationalizing her inertia and slovenliness on the excuse of pregnancy Such conduct should not be encouraged or even tolerated nor should the physician stand idly by while the mother to be imposes upon that arch criminal the expectant father

The Figure —One of the triumphs of modern woman has been the demonstration that pregnancy need not necessarily leave the mother with a misshapen appearance Proper exericse limitation of diet to prevent ex cessive weight gain adequate corseting and care of the skin make it pos sible to emerge from pregnancy with inappreciable physical changes

Expected Date of Confinement —The expected date of confinement is estimated by counting forward 280 days from the day of the onset of the last menstruation It is easily calculated by adding 7 days to the date of onset of the last normal period and counting backward 3 months (Nagele s rule) This date is correct in about 10 per cent of cases and in about 50 per cent delivery occurs within one week of the expected date

Toward the end of pregnancy the expectant mother is instructed re garding the symptoms and signs of the onset of labor This knowledge is comforting to the patient and will enable her to seek medical assistance at the proper time

TABLE 145—OBSTETRICAL TABLE

The calculation is made from the first day of the last menstrual period

January	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	January
October	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	*November*
February	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28				February
November	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5				*December*
March	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	March
December	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	*January*
April	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		April
January	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4		*February*
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	May
February	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	*March*
June	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		June
March	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6		*April*
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	July
April	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	*May*
August	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	August
May	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	*June*
September	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		September
June	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7		*July*
October	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	October
July	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	*August*
November	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		November
August	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6		*September*
December	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	December
September	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	*October*

lieve that alterations of hormonal equilibrium constitute the fundamental basis for such clinical entities as pernicious vomiting hypertensive toxemia habitual abortion and defects of placentation In the near future many of these problems may be clarified with resultant simplification and improvement of therapeutic endeavors

PERNICIOUS VOMITING OF PREGNANCY (HYPEREMESIS GRAVIDARUM)

In early pregnancy *nausea* and *vomiting* are so commonly observed as to be regarded as integral parts of normal gravidity In most instances these annoying disturbances are easily controlled by simple therapeutic measures They usually disappear at the end of the third or fourth month but occasionally they become excessive obstinate and uncontrollable leading to the serious complication of pernicious vomiting In older texts this condition has been classified as a toxemia of pregnancy in the present section this term is reserved for the acute vascular syndrome (p 2638)

Etiology—The causes of the nausea and vomiting of early pregnancy and the pernicious vomiting of pathologic significance are unknown at the present time Current theories include the possible presence of fetal or placental toxin or some dislocation of hormonal equilibrium At the present time these postulates are merely suggestive and the only observation to which all physicians will agree is the clinical fact that the disorder is more commonly seen in the highstrung hypersensitive woman with a neurotic background

Pathology—Pathologic changes are present in *liver* and *kidneys* of women who die of pernicious vomiting the liver is usually enlarged and shows an acute diffuse atrophy with fatty degeneration around the central vein extensive areas of necrosis are observed and in certain severe instances the findings are those of an *acute yellow atrophy* The kidneys reveal varying degrees of nephrotic change from mild to marked degeneration of the secreting tubules renal changes are often secondary to a primary hepatic injury and represent a form of the *hepatorenal syndrome*

Clinical Manifestations—The cardinal manifestations of pernicious vomiting are *uncontrollable nausea* and *emesis* The course is often intermittent with recurrences and short periods of quiescence Most often there is extreme *anorexia* even the sight of food leads to *salivation nausea* and a *paroxysm of vomiting* Later metabolic derangements are superimposed loss of gastric juice produces *dehydration hemoconcentration* and disturbances of *acid base equilibrium* (p 732)

Treatment—The prevention of pernicious vomiting is accomplished by prompt and vigorous treatment of the milder degrees of nausea and vomiting during early pregnancy Many women are relieved if they can be given a cup of warm water containing a teaspoonful of bicarbonate of soda or a cup of tea with the juice of half a lemon before they get out of bed Induction of vomiting acting as a type of gastric lavage may make tolerable the remainder of the day Frequent small feedings of warm or hot cooked dishes seem best handled using such foods as cereal milk toast soup mashed potato spaghetti or scrambled eggs At other times cold carbonated beverages such as charged water with or without the juice of a lemon or lime or dry ginger ale are more successful Nowhere in dietotherapy should the caprice of the appetite be more heeded often when

CHAPTER 124

OBSTETRICS: THE COMPLICATIONS OF PREGNANCY AND PLACENTATION; PREGNANCY AS A COMPLICATION

Complications of Pregnancy and Placentation
- Pernicious Vomiting of Pregnancy (Hyperemesis Gravidarum)
- Toxemia of Pregnancy
- Urinary Sepsis in Pregnancy
- Nephritis and Other Renal Disorders
- Hypochromic Anemia of Pregnancy
- Macrocytic Hyperchromic Anemia of Pregnancy
- Acute Hemolytic Anemia of Pregnancy
- Vaginitis of Pregnancy
- Neurologic Disturbances of Pregnancy
- Orthopedic Complications of Pregnancy
- Pregnancy Dermatoses
- Metabolic and Digestive Disturbances of Pregnancy
- Vascular Complications of Pregnancy
- Deafness and Pregnancy
- Acute Appendicitis in Pregnancy
- Abortion
- Hydatidiform Mole
- Chorionepithelioma
- Ectopic Pregnancy
- Placenta Praevia
- Premature Detachment of the Placenta
- Hydramnion
- Oligohydramnion
- Amniotic Adhesions

Pregnancy as a Complication
- Gonorrhea
- Syphilis
- Tuberculosis
- Cardiac Invalidism
- The Endocrinopathies
- Rheumatoid Arthritis
- Gallstones
- Rubella

THE COMPLICATIONS OF PREGNANCY AND PLACENTATION

Despite the tendency of the modern physician to regard pregnancy as a physiologic process the frequent occurrence of complications almost justifies the attitude of those who regard childbirth as a pathologic process Not only do derangements influence the health and welfare of the prospective mother during the period of gestation but they also cause serious aftermaths in the genital cardiovascular and urinary systems

There is as yet no clearly defined concept of the pathogenesis of many of the complications of pregnancy and placentation Hypotheses which stressed such mechanisms as emotional and physical shocks excessive protein in the maternal diet and fanciful exogenous factors are rapidly receding into the folklore of medicine There is an increasing tendency to be

observations is suggested by the demonstration that there is a decreased renal blood flow in toxemia Furthermore factors which tend to reduce renal blood flow such as ureteral and venous obstructions are commonly encountered in pregnancy The predisposing causes of toxemia include conditions associated with abnormal enlargement of the uterus such as twin pregnancies and hydramnios (p 2669)

Toxemia is associated with widespread *spasm* of small arteries and *capillary injury* such as is seen in *acute glomerulonephritis* (p 2373) Vascular damage hypertension and ischemia are the bases for the cardinal symptoms and signs as in other types of vascular disease (p 900)

Pathology —The characteristic lesions of toxemia are found in the *kidney liver* and *placenta* The renal lesion is first to occur and is in the nature of an *acute glomerulonephrosis* there is widespread tubular damage and evidences of glomerular epithelial and vascular degeneration Approximately half of the patients reveal local areas of necrosis in the periphery and mid zones of *liver lobules* The *placenta* invariably shows a premature process of aging with extensive infarction and syncytial degeneration In *eclampsia* the brain is congested and edematous with many small hemorrhages and areas of thrombosis in the smaller vessels

Clinical Manifestations —The cardinal clinical manifestations of toxemia of pregnancy are those based on the association of elevation of blood pressure the occurrence of edema and the superimposition of the syndrome of eclampsia

Hypertension —The most significant manifestation of toxemia is an abnormal rise of blood pressure during the last trimester of pregnancy This may occur in the normotensive patient or in the one who has had pre existent hypertension As a general rule the symptoms parallel the degree of hypertension and as in all other severe hypertensive states with a marked elevation the syndrome of *hypertensive encephalopathy* is encountered

IN NORMOTENSIVE WOMEN —With an appreciable increase in blood pressure such as 50 to 60 mm in the systolic readings the normotensive patient complains of *frontal headache disturbances in vision nausea* and *vomiting* In the majority of patients hyperpiesis is preceded by *edema* (p 706) and in the severe examples it is followed by *eclampsia* the convulsive phase of the disturbance

IN WOMEN WITH PRE EXISTENT HYPERTENSION —While a certain number of patients with *prepregnancy hypertension* from whatever cause pursue an uncomplicated course during the period of childbearing approximately half develop the toxemia of pregnancy In these instances the gestational derangement is *superimposed on the prepregnancy hypertension* The toxemia may subside before or soon after delivery and is infrequently associated with eclampsia

Pregnancy may have an early and deleterious effect on the progress of *chronic vascular disease* Not uncommonly a latent renal disorder becomes manifest for the first time during the first trimester of the gestational period Patients with known preexistent *chronic nephritis* experience an early increase in hypertension with albuminuria and edema There is progressive impairment of renal concentrating power and retention of nitrogenous products and uremia may be precipitated The patient with *essential hypertension* (p 900) may run a similar but somewhat less in

invalid food is rejected the woman craves and digests a vinegar pickle sour lemon drops and lollypops a herring bacon or a glass of beer

Because of the desire for sour foods we advocate routine use of Dilute Hydrochloric Acid (N F) using 2 to 4 cc doses in water before meals or capsules of acidulin Following each principal meal a sedative is given as 15 mg (¼ grain) of phenobarbital or preferably a teaspoonful of Mistura Nigra (p 1757) At bedtime a hypnotic is indicated, using 90 mg (1½ grains) of sodium seconal or any related preparation (p 3836) We have no great enthusiasm for the gastric sedatives other than Mistura Nigra (p 3840) but daily intravenous injections of pyridoxine hydrochloride (1 cc = 50 mg) may prove helpful

Should simple therapy fail to control the distress the patient may be given intramuscular injections of 1 mg of progesterone (p 2517) or intravenous injections of 50 to 100 mg of thiamine chloride (p 622) or 20 cc of 50 per cent dextrose

With evidences of dehydration or acidosis *parenteral fluids* are administered An *intravenous drip* (p 3775) is instituted using 5 per cent dextrose in saline as the infusate Small doses of *insulin* (p 1237) are added to insure the burning of the dextrose As an alternative or associated form of therapy *transduodenal feedings* (p 1752) are maintained until vomiting is controlled

With persistence of symptoms and deterioration of the condition of the mother *dilatation* and *curettage* is indicated for the termination of the pregnancy

THE TOXEMIA OF PREGNANCY (HYPERTENSIVE TOXEMIA ECLAMPSIA THE NEPHRITIS OF PREGNANCY)

The toxemia of pregnancy is more properly regarded as a *hypertensive syndrome* resulting from *acute vascular disease* The vascular changes are associated with edema albuminuria and cerebral manifestations that appear during the latter half of pregnancy and regress after parturition

Hypertensive toxemia of pregnancy occurs in approximately 5 per cent of women delivered in the hospitals of the United States The average *maternal mortality* is 1 7 per cent in mild examples and 13 per cent in those who are severely afflicted and who experience convulsions the *fetal mortality* approximates 25 per cent

Over and beyond the immediate ravages of this disorder many mothers who survive the toxemia maintain or later develop *chronic hypertensive vascular disease* and progress to cardiovascular invalidism

Etiology and Pathogenesis—Although the cause of hypertensive toxemia is presently unknown a variety of theories have been suggested These include toxin production by the fetus toxin production from placental infarction *hyperactivity of the adrenal cortex* (p 1268) hyperfunction of the posterior pituitary gland and an imbalance of estrogen and gonadotropin

The relationship between ischemia (p 2273) and hypertensive vascular disease may have an interesting application in the etiology of toxemia pregnant dogs are more sensitive to small reductions in renal blood flow than are nonpregnant animals Clinical application of these experimental

the retinal arterioles and *retinal detachment* The liver becomes enlarged in the presence of heart failure

Laboratory Findings —The *urine* shows a moderate to large amount of albumin and contains casts and a few red blood cells Marked *hematuria suggests an acute nephritis* (p 2373) rather than a toxemia Renal function is unimpaired grossly in the nonconvulsive cases but there is often oliguria and anuria in the eclamptic phase Death from uremia is rare in the absence of an antecedent chronic renal disease

Renal function tests reveal a decrease in urea and uric acid clearances and in renal blood flow The chemical composition of the *blood* is normal in most respects values for blood sugar urea nonprotein nitrogen and serum electrolytes are unchanged However in both mild and severe cases the blood uric acid is increased The *blood protein concentration* is often slightly lowered In the eclamptic phase there are sharp rises in urea and nonprotein nitrogen and a fall in carbon dioxide combining power chiefly as a result of cardiorenal failure and vomiting

Despite the frequent presence of hepatic lesions in eclampsia *liver function tests* (p 1947) are normal and the *basal metabolic rate* (p 3738) is within normal limits

Course and Complications —Clinical improvement in hypertensive toxemia is accompanied by a brisk diuresis Continuance of oliguria and the onset of anuria are bad prognostic signs Following the onset of diuresis blood pressure falls abruptly to normal within a few hours or may initiate a slow steady decline over a period of weeks or months The degree of albuminuria subsides slowly over the course of several weeks

The onset of eclampsia is often accompanied by spontaneous *premature birth stillbirth* or *maternal death* Almost 25 per cent of normotensive women who develop a hypertensive toxemia during pregnancy manifest a permanent hypertension within five to ten years after delivery A similar percentage of prepregnant hypertensives who develop super imposed toxemia during pregnancy show a marked increase in the severity of vascular phenomena within five years

The late vascular aftermaths of toxemia are related more to the duration of the disturbance than to its intensity Mild degrees of toxemia of long duration are most likely to eventuate in permanent hypertension

Treatment —The present state of ignorance concerning the etiology and pathogenesis of hypertensive toxemia limits the therapeutic endeavors of the physician to symptomatic therapy accomplished by diet sedation the use of diuretics and measures for the termination of pregnancy Ambulatory or home treatment is instituted in the mild cases but hospitalization is required for protracted or severe toxemias

Ambulatory or Home Treatment—Ambulatory or home treatment of pregnancy toxemia is limited to prescriptions for diet simpler diuretics and sedatives

DIET —With the onset of edema the patient is ordered to approximate a 2000 calory intake high in carbohydrate and protein but low in fat The low protein intake of the past should be no longer countenanced (p 675) The presence of nausea vomiting and capricious appetite makes it impossible to follow set meals and it is more practical to give a list of recommended foods than a fixed menu Breakfast should include fruit juice

tense progressively unfavorable course *Cardiac failure* is a constant threat *convulsions* are somewhat more common in this group of individuals than in those with chronic nephritis and fetal mortality approaches 47 per cent due to *abortion premature labor extensive infarction* and *accidental hemorrhage*

Edema—The hypertension of the toxemia of pregnancy is usually accompanied by and more often preceded by generalized *edema* and *proteinuria* Mild degrees of generalized edema are common features of pregnancy they are of no disturbing significance in the absence of hypertension but are of ominous import when observed in conjunction with the vascular abnormality

The patient commonly notices that her rings are too tight an evidence of edema of the fingers Eyelids and ankles swell and there is more than the usual weekly increment in weight The appearance of puffiness attracts the attention of the patient and the physician notes alteration in the level of blood pressure Less often the hypertensive patient notes the sudden appearance of edema or rapid development of a generalized anasarca

The mechanism of edema formation is unknown but there is a strong suggestion that retention of water and sodium results from increased activity of the adrenal cortex (p 1266)

Eclampsia—Eclampsia was formerly regarded as a distinct form of toxemia but is more likely the most severe clinical variety of the hypertensive complication of pregnancy It has ominous prognostic significance

In the majority of eclamptic patients the onset of the *convulsive phenomena* is observed in those who have been exhibiting a slowly developing syndrome with gradual increase of blood pressure and water retention during the last month of pregnancy Less often the eclamptic episode is explosive and unforeseen Occasionally eclampsia occurs for the first time during labor or in the early days of the puerperium but it is never encountered for the first time after the fourth postpartum day

The convulsive episode is commonly preceded by *prodromes* such as sharp *epigastric pain* partial or complete *amaurosis* or severe *frontal headache* the fullblown phase is characterized by a *generalized convulsion* of the *epileptiform type* seizures are tonic at first, then they become *clonic* and are attended by *unconsciousness* The onset of convulsions marks the progression of the toxemia from a mild to a severe disorder

Convulsions may be single or frequent following in rapid succession until the patient dies of exhaustion Any slight sudden stimulus such as a jar a flash of light, a loud noise or a pin prick may elicit a *motor* discharge *Cardiac failure* attended by *acute pulmonary edema* is a frequent cause of death For reasons that are not clear the patient with a pre-existent hypertension and superimposed toxemia is less likely to experience convulsive episodes than previously normotensive women

Physical Examination—Physical examination during the course of a hypertensive toxemia, reveals *elevation of blood pressure* and evidences of *edema* In the eclamptic phase the blood pressure readings usually exceed 220/150 The heart is enlarged probably as the result of acute dilatation the sounds are apt to be impure and there may be *gallop rhythm* Eyegrounds reveal *papilledema retinal hemorrhages soft exudate spasm of*

Septic Abortion	History of illegal operation may be suppressed. Look for evidences of instrumentation of cervix (p 2650) Notify authorities Admit to hospital for intensive anti infective therapy with penicillin and sulfonamide (p 10b)

cooked cereal 2 eggs toast and tea coffee or skimmed milk with added sugar on cereal and in the beverage Luncheon and dinner are arranged around a principal course of meat fish poultry or cheese supplemented by a starch (potato macaroni spaghetti or noodles) 2 vegetables bread and jam and a simple dessert If the whole meal cannot be taken at a single session the remainder is saved for an in between feeding

The list of banned foods includes butter cream bacon lard and olive and other oils The intake of sodium chloride is reduced to a minimum of about 1 gm daily by omitting salt in cooking or at table and by forbidding salt foods such as pork ham herring and the like

Fluids need not be restricted unless the edema progresses despite salt limitation Beside sodium chloride sodium bicarbonate and sodium citrate are also on the forbidden list

DIURETICS —If dietotherapy fails to relieve edema tablets of *potassium* or *ammonium chloride* are administered orally in 2 gm doses three times daily *Mercurial diuretics* are avoided since they tend further to damage the kidneys Fluid restriction need not be enforced unless dietotherapy and the combined use of diuretics has proved ineffective

SEDATION —*If the patient fails to respond to simple therapy she is* urged to go to bed at home Daily visits are required by the practitioner in order to observe changes in weight blood pressure albuminuria and other symptoms Sedation is accomplished by the administration of 15 mg (¼ grain) of *phenobarbital* three times daily and a hypnotic (p 3836) at bedtime Visiting is restricted and disturbing influences are eliminated

Hospital Treatment —In the presence of severe or persistent toxemia the patient is urged to enter the hospital With the onset of visual cerebral or gastro intestinal symptoms intramuscular injections of 20 cc of 10 per cent *magnesium sulfate* (p 3824) are administered The antidote of 10 cc of 5 per cent calcium chloride is kept on hand for intravenous use in case of respiratory failure *Sodium luminal* is given subcutaneously in 0 3 gm (5 grain) doses and recourse is had to enemas of *chloral hydrate* (2 gm in 100 cc of starch paste) repeated every six to twelve hours with injections of *morphine sulfate* or *demerol* (p 3863) as indicated *Lumbar punctures* may be of value older clinicians still have faith in *Veratrum viride* (p 3896) whose use we deplore

The onset of convulsions calls for increased sedation and prompt emptying of the uterus

The Termination of Pregnancy —With failure of improvement of the patient s condition or a protracted static toxemia it is best to terminate the pregnancy under the most favorable conditions Since the duration of the toxemia is of greater importance in the pathogenesis of late complications than its intensity the uterus is emptied after slight hypertension and albuminuria have persisted beyond a period of three weeks If the

DIFFERENTIAL DIAGNOSIS OF

Special Causes of Fever Associated with Pregnancy

The pregnant woman may suffer from any of the causes of fever to which the non pregnant individual is exposed The pecial factors related to the pregnancy are listed below but the practitioner must bear in mind that add tionally pregnancy may activate a qu escent tuber culosis rheumatic fever brucellosis or other types of chronic infection.

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	Up to 100 4 for the first two or three days following delivery May be a sociated with leukocyto is of 15 000 to 18 000 despite absence of infection
Mammary	Caked breast Acute mastitis (p 2612) Anti infective therapy with penicillin (p 106) Prepare for ncis on and drainage if nece sary (p 3978)
Urinary	Pyelonephritis (pyelitis) with pyuria (p 2353) If anti infective therapy is unsuccessful pre pa e for cysto copy and ureteral catheteriza tion for drainage of pyonephrosis (p 2249)
Uterine	Lacerations with secondary infection of cervix and soft parts following labor Retained secundines (p 2717) Puerperal fever with endometritis parametritis and pelvic periton itis (p 2606) Intensive treatment with penic illin and sulfonamide (p 88) Perforation of uterus following curettage or forceps delivery Intensive t eatment with penicillin and sul fonamide in preparation for hysterectomy (p 106)
Circulatory	Thrombophlebitis or phlebothrombosis of pelvic or extremity veins (p 2604) Supple ment intensive therapy with penicillin and sulfonamide (p 88) with heparinization (p 1050) Prepare for ligation of accessible veins if possible
Pulmonary	Embolization from thrombus originating in pelvic or extremity veins Treat as above but surgery mandatory (p 1124) Post anesthetic pneumonitis (p 2189) Try probatory course of penicillin therapy (p 106)
Systemic Infection	Bacteremia with puerperal fever (p 2606) Get blood culture (p 53) Start intensive anti infective therapy (p 106) Activation of pre-existent tuberculosis rheumatic fever or brucellosis Test with tuberculin and brucel lergin (p 59) Note therapeutic test with salicylate in rheumatic fever (p 186)
Hemic	Acute hemolytic anemia with rapid onset of jaundice and phenomenon of iso-agglutination (p 1060) Transfu e with Rh negative blood (p 3778)

CONTINUED

if untoward effects are to be avoided The urine is kept alkaline by the daily administration of 6 to 8 gm of bicarbonate of soda With persistent or grave manifestations sulfonamide therapy is supplemented by intramuscular injections of 250 000 units of streptomycin (p 104) four times daily

Hospital Treatment—With obstinate or severe infection the patient is advised to seek admission to the hospital The urine is cultured to ascertain the nature of the invading organism and test its sensitivity to sulfonamides streptomycin and penicillin Intramuscular injections of penicillin may be added to the sulfonamide or streptomycin courses The initial dose may be 40 000 units with subsequent injections of 20 000 every three or four hours

With persistence of infection or frequent recurrence a mechanical factor is suspected and an *intravenous urogram* (p 2251) is indicated to detect the possible presence of *stones* congenital anomalies or *anatomical obstruction* At the same time it is possible to estimate the amount of damage that has occurred as the result of pyelonephritis With positive findings it may be wise to pass *ureteral catheters* and leave them in situ for five to six days Through them the urinary pelvis is irrigated every two hours with a penicillin solution or boric acid Finally if these measures fail pregnancy must be interrupted (p 2649)

NEPHRITIS AND OTHER RENAL DISORDERS

Acute nephritis is rarely seen in pregnancy Should it occur it is managed in the manner of eclampsia (p 2641)

Women with prepregnancy hypertensive renal disease are poor subjects for pregnancy since they are prone to develop *toxemia* (p 2638) Their chances of bearing a live child are impaired and the risk to the maternal organism is great since pregnancy usually accelerates the downhill course of *renal* and *cardiorenal disorders* (p 2362) Interruption of pregnancy must receive careful consideration before irreparable damage is inflicted

THE HYPOCHROMIC ANEMIA OF PREGNANCY

A fall in the *red blood count* and *hemoglobin concentration* is common in gravid women Approximately 50 per cent of the pregnant manifest a red blood count below 3 5 million during the final trimester Part of this fall is apparent rather than real and results from *hemodilution* In most instances however there is also an associated defect in *erythropoiesis* (p 1038) due to gastric anacidity and iron deficiency

Clinical Manifestations—Ordinarily hypochromic anemia is asymptomatic and is revealed by the routine blood count In more advanced instances the patient complains of *fatigability loss of appetite dyspnea* and *edema* which appear during the fifth and sixth months

Examination often reveals some atrophy of the *lingual papillae* Brittle spoon shaped *nails* and enlargement of the *spleen* are observed in a few patients *Gastric acidity* is invariably decreased if there is not a complete *achlorhydria* (p 3723) The *hemogram* corresponds to that of any secondary anemia with a *low color index*

Treatment—The prophylactic treatment of hypochromic anemia should be begun no later than the second trimester of the pregnancy Before meals

period of gestation has not reached the twenty sixth week it is probably wiser to evacuate the uterus after a week of adequate treatment

The termination of pregnancy after the twenty sixth week is conducted by the simplest possible technical method compatible with the condition of the cervix If the cervix is soft effaced and dilatable, labor is induced by rupture of the membrane Cesarean section and accouchement force are avoided if possible However if the cervix presents an impenetrable barrier *cesarean section* is indicated

URINARY SEPSIS IN PREGNANCY (PYELONEPHRITIS OR PYELITIS OF PREGNANCY)

Bacterial invasions of the urinary tract occur in 1.5 to 2 per cent of pregnant women They are perhaps the commonest intercurrent infections of gravidity and are usually encountered during the second trimester or in the puerperium

Pathogenesis and Etiology—It is likely that ureteral dilatation and obstruction resulting from enlargement and torsion of the uterus produce *urinary stasis* and a *retrograde flow* constipation which is common during gravidity is a contributory factor In many instances urinary infection is preceded by an *upper respiratory inflammation* suggesting that the invader is carried to a place of lessened resistance through the blood stream

Women who have had a previous infection during an earlier pregnancy are prone to recurrence Although the urinary infection of pregnancy is commonly termed a pyelitis' it is more likely a *pyelonephritis* since the inflammatory reaction is not localized to the urinary pelvis The usual invading organisms are *colon bacilli* and *streptococci*

Clinical Manifestations—Most often urinary tract infection is *asymptomatic* until microscopy reveals the presence of a pyuria or bacilluria These findings may be absent if the affected ureter is completely blocked

In virulent infections the patient suffers from *chills fever* and *general malaise* The origin of the sepsis is established when the urine is examined microscopically or by culture In other instances the disturbance is announced by urinary symptoms such as *frequency dysuria* or *tenesmus* Other than *jar tenderness* in the lumbar region and some palpable enlargement of the kidney the physical examination is uninformative

Treatment—The *prevention* of urinary infection during pregnancy is attempted by prescribing a large fluid intake to insure the passage of a dilute urine correction of constipation and provision for adequate abdominal support Bed rest is ordered during the course of even a mild upper respiratory infection Those multiparae who have had severe infections in previous pregnancies and residual kidney damage should on the slightest provocation be given prophylactic doses of *sulfadiazine* (p 88)

Home or Ambulatory Treatment—In most instances urinary infection in pregnancy can be managed at home or by ambulatory treatment Main reliance is placed upon the oral administration of *sulfathiazole* or *sulfadiazine* (p 88) A daily dose of 4 gm continued for five to seven days usually suffices During this period the daily output of urine is kept at 1000 to 1200 cc in order to insure an optimal concentration of the drug and yet prevent the urinary precipitation of crystals Repeated examinations of the urinary sediment and frequent blood counts are mandatory

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Treatment—The prophylactic treatment of hypochromic anemia should be begun no later than the second trimester of the pregnancy Before meals

2 to 4 cc of Dilute Hydrochloric Acid are given in ¼ to ½ glass of water After each meal a tablet or capsule of 0 3 gm (5 grains) of Ferrous Sulfate is prescribed

Upon the appearance of anemia acid administration is continued and larger doses are given if possible The iron dosage is stepped up to 2 gm daily unless the preparation causes digestive symptoms Additionally it is wise to give the patient intramuscular injections of *liver extract* (p 1082) or a *transfusion* of whole blood

Following delivery the blood count returns rapidly to normal but the infant born of an anemic mother requires supplementary *iron*

THE MACROCYTIC HYPERCHROMIC ANEMIA OF PREGNANCY (PERNICIOUS ANEMIA OF PREGNANCY)

The macrocytic anemia of pregnancy is a deficiency phenomenon that occurs during gestation It seems to result from a drastic reduction in the intake of animal protein and is associated with *nausea vomiting diarrhea* and *anorexia* There is often present a *glossitis* (p 1707) as seen in the vitamin deficiency states and low grade *pyrexia* is noted

Examination of the blood reveals a macrocytic hyperchromic anemia with a *color index* above unity The stained spread shows *poikilocytosis*

DIFFERENTIAL DIAGNOSIS OF

The Anemias of Pregnancy

Physiological	In early months Hypochromic due to increased plasma volume
Hypochromic	In second half Hemoglobin less than 50% subacidity or anacidity Responds to acid and iron
Hyperchromic	High color index but no glossitis or anacidity Responds to liver extract

and *anisocytosis* (p 3692) *Leukocytes* and *platelets* are normal in number or reduced *serum bilirubin* is increased and the *bone marrow* is hyperplastic

The presence of the macrocytic anemia of pregnancy requires ingestion of an adequate diet (p 1052) *hydrochloric acid* is given before meals and injections of *liver extract* are mandatory Since there is often an associated iron deficiency *ferrous sulfate* is prescribed daily in 1 to 2 gm (15 to 30 grain) doses Folic acid in 10 to 30 mg doses may be substituted for liver extract

THE ACUTE HEMOLYTIC ANEMIA OF PREGNANCY

An acute hemolytic anemia resembling that described by Lederer (p 1073) may develop suddenly during pregnancy and produce sufficiently severe and persistent manifestations to warrant *therapeutic abortion* (p 2649) The onset is acute with *chills fever gastro intestinal and urinary symptoms pallor* and *jaundice* The lymph nodes liver and spleen enlarge and *purpura hematuria* and *retinal hemorrhages* appear The red blood count falls to the region of a million cells per cubic millimeter *Red cell fragility* is usually normal and the *leukocyte count* is somewhat increased

The cause of the acute hemolytic anemia is presently unknown but it is suggested that it is related to the *Rh factor* of significance in *erythro blastosis foetalis* (p 1067)

The condition is treated with *transfusions* of Rh negative blood and the administration of *alkali* to prevent precipitation of *hemoglobin* (p 2372) Pregnancy must be terminated *Splenectomy* is of dubious value and involves considerable risk

VAGINITIS OF PREGNANCY

Vaginitis resulting from infestation with *trichomonas* (p 2598) or *monilia* (p 2598) is apt to be particularly severe during pregnancy The condition is recognized by microscopic study of vaginal discharge Treatment is carried out as in the nonpregnant state but must be more persistently pursued

NEUROLOGIC DISTURBANCES OF PREGNANCY

Neurologic and psychiatric disturbances are rarely encountered in pregnancy except as exacerbations of previously existent conditions or as coincidental happenings

Chorea—Old textbooks speak of the frequency with which *chorea* (p 1417) is encountered in pregnancy Certainly this does not seem in accord with modern experience If the two conditions coexist it is likely that the occurrence is accidental

Psychoses—Whereas it is unlikely that there is any specific pregnancy psychosis many psychotic patients date the onset of their mental disturbance to the period of gravidity In these instances the pregnancy through its physical and emotional content constitutes an exciting incident in a patient of psychopathic constitution

Epilepsy—Epileptics tolerate pregnancy well Some experience a diminution in the number and intensity of seizures (p 1515) The epileptic mother may be assured that her child has a numerically slim chance of inheriting her affliction The continued use of *phenobarbital* and *dilantin sodium* (p 1517) has no deleterious effect on the fetus

Neuritis—The neuritis of pregnancy is probably a manifestation of *thiamine deficiency* (p 622) It is rarely encountered and should yield to dietotherapy and administration of vitamin B complex The sciatica of pregnancy results from faulty mechanics in the lumbosacral area and is treated as any other lesion in this vicinity (p 3072)

ORTHOPEDIC COMPLICATIONS OF PREGNANCY

The mechanics of posture are badly strained during the course of pregnancy Many annoying and painful disturbances initiate during pregnancy Almost all may be prevented with little difficulty

Low Back Pain and Sciatica—Abdominal protrusion and relaxation of pelvic ligaments lead to the frequent complaints of *low back pain* (p 3072) and *sciatica* These are caused by *lumbosacral sprains* (p 3057) which do not differ from those of nonpregnant states Prevention is accomplished by adequate *corseting* and *shoeing* instructions in correct *posture* (p 3492) and insistence upon *simple exercises* (p 3757) An associated sciatica is

treated as in the nongravid states and may be phenomenally alleviated by injections of *procaine* (p 3915)

Slipping Rib —Just before "lightening" occurs in the last trimester of pregnancy the lower ribs are often widely spread As a result *acute sub costal pain* may develop from subluxation of the free ribs Should this occur on the right side, the condition simulates a *gallbladder colic* (p 2000), on the left it may be thought that the patient has an *angina* (p 890) or a *renal stone* (p 2314) The condition is easily recognized by demonstra tion of a local and exquisite *point of tenderness* and by reproduction of the pain when the ribs are slipped one over the other

Treatment of slipping rib is difficult as strapping often adds to dis comfort In the event of severe pain, a local injection of procaine is attempted That failing however it may be necessary to remove the end of the rib

PREGNANCY DERMATOSES

The normal pigmentary phenomena of pregnancy are elsewhere de scribed (p 2625) The unique tegumentary manifestations include *herpes gestationis* and *impetigo herpetiformis* (p 3371) Pruritus dermographism and urticaria are encountered with more than usual frequency

A pre existent dermatosis is often favorably influenced by gravidity This is particularly recognized in *acne vulgaris* (p 3358) and adds weight to the hypothesis that this disturbance may be due to a dislocation of the androgen estrogen ratio

METABOLIC AND DIGESTIVE DISTURBANCES OF PREGNANCY

Many women emerge from pregnancy with *obesity* and *gallstones* but minus several *teeth*—corroborating the adage that each child cost a tooth and gained a gallstone

There is no need in modern obstetrics to tolerate these complications Obesity is preventable by dietotherapy (p 3334) the woman may main tain her youthful figure by limiting her food intake proper corseting and taking adequate exercise The occurrence of gallstones is less likely if a *low fat diet* is followed through pregnancy *Dental decay* (p 1663) is pre vented by following the simple rules of dental hygiene (p 1658) and the correction of all caries in the first trimester

VASCULAR COMPLICATIONS OF PREGNANCY

The most devastating vascular complication of pregnancy is hyperten sive toxemia (p 2638) Additionally pelvic congestion and infection may result in *phlegmasia alba dolens* the milk leg of pregnancy and *varicosi ties* (p 969) Milk leg is a sequel to *suppurative thrombophlebitis* (p 2606) such as accompanies *puerperal* or *postabortal endometritis* (p 2602) *Vari cosities* are mechanical in their origin they may be prevented by proper corsets and shoes They should be obliterated after delivery by the in jection of sclerosing solutions (p 3939)

DEAFNESS AND PREGNANCY

There is a widely prevalent view that pregnancy increases deafness and may be a predisposing factor in *otosclerosis* (p 2095) Many otologists

favor therapeutic abortion in the woman with impairment of hearing provided she is more anxious to preserve her auditory sense than bear her child

There is not sufficient present information for the practitioner to give a definitive opinion concerning this situation Should it arise in his practice he may delineate the problem to mother and husband who may if they so elect visit a consulting otologist for more expert opinion

ACUTE APPENDICITIS IN PREGNANCY

Acute appendicitis (p 1881) is not uncommon in pregnancy It produces somewhat atypical manifestations due to enlargement of the uterus which displaces the appendix upward In consequence pain and tenderness are located somewhat higher in the right quadrant than is to be expected in the nongravid state the tendency of the infectious process to wall off is impaired by the contractility of the uterus so that *rupture of the diseased appendix* is more frequently experienced with the development of *acute diffuse peritonitis* (p 1931)

In early pregnancy appendicitis is readily confused with *ectopic pregnancy* or *threatened abortion* (p 2651) In the latter instance the occurrence of *vaginal bleeding* is usually diagnostic With an ectopic pregnancy a final and definitive opinion may require *diagnostic laparotomy* since blood counts and sedimentation rates may be quite confusing The differentiation *in the last analysis is of academic importance since either condition* requires surgical interference

ABORTION

Pregnancy may be terminated by spontaneous therapeutic or illegal abortion before the viability of the fetus in the twenty seventh week of gestation The interruption of gestation is of tremendous importance to medicine and the national economy for it takes an appalling toll of human life It has been estimated that one third of all maternal deaths result from abortion

Etiology—Interruption of pregnancy may result from *spontaneous cause* it may be induced as a *therapeutic necessity* to conserve the life or health of the mother whose welfare is in jeopardy it may be performed *illegally* by illicit means

Therapeutic Abortion—Therapeutic abortion requires the sanction of the parents and specialist consultants Most states demand certification and registration of the procedure and filing of a death certificate for the fetus Legitimate indications are the presence of menacing obstetric or systemic complications The former include *pernicious vomiting of pregnancy hypertensive toxemia* or *disturbances of placentation* The more general indications are the presence of *chronic disease* of kidneys nervous system blood vessels or heart rubella (p 2675) and *protracted infection* such as tuberculosis syphilis rheumatic fever or subacute bacterial endocarditis

Therapeutic abortion is best performed in an accredited hospital with records clearly signed by all involved in order to avoid medicolegal repercussions

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is extremely sensitive to unfavorable environmental conditions but becomes progressively more able to withstand disturbances as it develops

Deficiency of vitamin E produces *intra uterine death* and a resorption of the fetus in the experimental animal (rats) There is little likelihood that the condition is simulated in humans though enthusiasts have reported the successful treatment of *habitual abortion* (p 2653) by means of the administration of *wheat germ oil* a rich source of this vitamin

FETAL CAUSES—Abortion is produced by alterations in germ plasm as well as by maternal and paternal defects About one third of aborted fetuses are malformed In these instances it is difficult to determine whether the disturbance was fetal in its initiation or whether it resulted from defective sperm ovum or placentation

Abortifacient Drugs—Abortifacient drugs are more likely to injure the mother than cause expulsion of the fetus As elsewhere discussed (p 2510) the advocates of pharmacological abortion do not understand that the uterus is not sensitive to oxytocics until it approaches term Thus the persistent administration of potent drugs results only in maternal poisonings such as *acute ergotism* (p 2510) or *cinchonism* (p 862) *Posterior pituitary preparations* (p 2511) cause intestinal cramps and nothing else and *neostigmine* will effect uterine bleeding only if the uterus is nongravid

Large doses of *estrogenic hormone* terminate pregnancy in the experimental animal and similar results have been obtained in the human but certainly this procedure is not recommended Abortion may be produced by *roentgen therapy* but this method has hazards for the mother and if the uterus is not emptied may result in fetal malformations and monstrosities

Pathology—Before the eighth week ovum and decidual lining of the uterus may be expected to be expelled en masse Between the eighth and twelfth weeks *chorionic villi* become firmly anchored and may be retained even though the membranes are unruptured on expulsion By the end of the third trimester abortion simulates labor and the *placenta* may be partially or even completely retained giving rise to *continued bleeding*

Clinical Manifestations—*Early abortion* occurs at any time during the first three months of gravidity *Late abortion* or *miscarriage* is encountered between the fourteenth and twenty seventh weeks of pregnancy and retention of membrane is to be expected

Threatened abortion refers to the clinical state that occurs early in pregnancy marked by vaginal bleeding with or without pain An *inevitable abortion* is attended by bleeding pain and dilatation of the cervix *Complete abortion* is seen up to the twelfth week and the ovum and decidua are expelled in their entirety *Incomplete abortion* occurs after the twelfth week and portions of the gestational membranes are frequently retained within the uterine cavity A *missed abortion* denotes the retention of the dead ovum in the uterus and may lead to the formation of a mole (p 2654) *Septic abortion* is encountered when the uterine cavity which has been completely or incompletely emptied becomes infected *Habitual abortion* refers to repeated episodes of spontaneous evacuation of the uterus

Threatened Abortion—Threatened abortion is indicated by slight *vaginal bleeding* with little or no pain The *cervix* is closed and its canal is not shortened Treatment at this stage may be effective in preserving the pregnancy (p 2653)

Illegal Abortion—Illegal abortion is performed under less than optimum conditions by those who at the behest of the mother, destroy life at its inception for other than legitimate medical indications The penalty for the performance of illegal abortion is severe The death of the mother resulting from such a procedure constitutes *homicide* in the eyes of the law Whether or not the fetus is viable the action constitutes moral and biological *murder*

The practitioner is frequently in contact with the problem of illegal abortion Each community has its abortionist and many women foolishly attempt to induce miscarriage by drugs and self instrumentation Under any circumstance as soon as difficulties arise the general practitioner is brought into the picture for the purpose of pulling the chestnuts out of the fire The situation is full of hazard for all concerned It is a clear legal obligation of the physician to report to the proper authorities the fact that an illegal abortion has been performed Should he be remiss in his obligation to the community he is placing himself under jeopardy of the law

Once the abortion has been performed and the patient is bleeding or infected the practitioner may then conscientiously take charge of the situation He is wiser if he removes the patient to an accredited hospital so that he has full protection for future exigencies The treatment of *post abortal endometritis* which is frequently encountered is elsewhere discussed (p 2608)

Spontaneous Abortion—Spontaneous abortions result from paternal maternal or fetal causes

PATERNAL CAUSE—Abortion may result from a defect in *spermatogenesis* (p 2399) when the father is diseased or at an advanced age It may be due to the presence of chronic disease or intoxications such as chronic nephritis syphilis chronic lead poisoning chronic alcoholism and chronic suppurative disease of seminal tract or gonads If a defective sperm succeeds in accomplishing fertilization the product of conception is more than ordinarily apt to be defective

MATERNAL CAUSE—The most frequently encountered causes of spontaneous abortion result from maternal defects which interfere with the nutrition or health of the developing fetus The lesion may be *local* in the female pelvis as gonorrhea pelvic tuberculosis the presence of pelvic tumors or uterine displacements *systemic factors* include syphilis and endocrine disorders such as *hypothyroidism* and deficiency of the secretion of the *corpus luteum* Untreated *diabetics* are prone to abort in the early months probably as a result of a deficiency in endometrial glycogen Among other systemic disturbances that interfere with the development of the fetus and produce abortion are chronic nephritis essential hypertension cardiac disease the acute infectious diseases and the toxemias of pregnancy

Trauma is commonly regarded as a frequent factor leading to abortion In early pregnancies the newly embedded ovum may be dislodged by a fall excessive coitus shock fatigue and surgical procedures The uterus is more sensitive to extraneous influences at the time of the expected menstrual period During early gestation the expectant mother is advised to avoid strenuous physical activity at these times since the young ovum

regress and the urine tests become negative but the patient feels heavy and experiences low grade fever anorexia and malaise In extreme instances the fetus is retained for many months

Septic Abortion—Infections of uterus and parametrial tissues are dire complications of abortion attended by an appreciable mortality whether they result from spontaneous therapeutic or illegal evacuation of the cavity In the *majority of instances infection* follows the illicit ministrations of an abortionist of which circumstance the patient often gives a false and misleading history

The local manifestations are slight or absent *vaginal bleeding* but in practically every case there is a foul and often malodorous *discharge* Systemic phenomena include fever chills leukocytosis and the symptoms of generalized bacterial invasion

See *Septic or Postabortal Endometritis* (p 2606)

Habitual Abortion—The habitual abortion is one which recurs usually at the same time and under similar circumstances in successive pregnancies The causes are often demonstrable and include systemic diseases such as syphilis chronic infections and cachectic states Local abnormalities often are present as in the case of *uterine fibroids* (p 2554) and *uterine displacements* (p 2537) Finally the disturbance may be noted without apparent systemic or local causation as a probable manifestation of a glandular imbalance possibly related to *progesterone deficiency* It is often prevented by bed rest sedation and injections of progesterone (p 2517)

Treatment—The treatment of abortion is largely an individual problem which depends in great part upon the duration of gestation the completeness with which fetus and membranes have been expelled and the complicating presence of infection

Threatened Abortion—The patient who has a threatened abortion is disturbed as little as possible as the slightest manipulation may precipitate evacuation of the uterus The patient is kept *in bed* and given large doses of *sedatives* or an *opiate progesterone* in intramuscular doses of 1 mg daily exercises a sedative effect on uterine muscle Enemas and cathartics are avoided since they may offset the progesterone effects The amount of bleeding is estimated by examination of the pads frequent estimations of the hemoglobin concentration and the erythrocyte count (p 3696) If the mother s general condition remains satisfactory and the pregnancy test is still positive expectant treatment may be continued even if it is necessary to do a blood transfusion to correct the anemia

Inevitable Abortion—When it becomes apparent that abortion is inevitable immediate measures are taken to encourage complete *evacuation of the uterus* If there is little bleeding a rigid cervix and a uterus enlarged beyond the size of a three months gestation the cervix is gently dilated and the canal and uterine cavity are packed At the end of forty eight hours packing is removed and fetus and membranes may be expelled If expulsion is incomplete the cervix is further dilated under anesthesia and the products of conception are removed instrumentally

With profuse bleeding and a dilated cervix the uterus is emptied immediately under general anesthesia The products of conception are separated from the uterine wall by a blunt curette or uterine ring forceps but sharp curettes are avoided Following removal of tissue the uterine cavity

During the *first three months* of gravidity, slight vaginal bleeding *not necessarily indicate that abortion is imminent since the blood* come from a portion of the endometrium that is not covered by m brane Such bleeding has been regarded as analogous to menstruation *is relatively frequent* However the possibility of an ectopic pregna (p 2657) must be kept constantly in mind The differential diagnosi made apparent by physical examination During the *second trimester* e slight bleeding is an invariable sign of threatened abortion

Inevitable Abortion—Threatened abortion becomes inevitable w symptoms intensify *bleeding* is more profuse and persistent and the tient complains of colicky fairly severe *low abdominal pain* An ase vaginal examination is indicated for purposes of diagnosis and progno If the cervical os is open abortion is inevitable and steps are taken empty the uterus at the earliest possible moment Delay may result exsanguination and the development of shock

Less typically the patient complains only of *mild backache* an watery vaginal discharge In other instances abdominal discomfort is proportionate to bleeding and there is a suspicion that the condition is *acute appendicitis* (p 1881) or an *ectopic gestation* (p 2657) In the mer there may be definitive evidences of infection such as pyrexia leukocytosis but this is not a necessary accompaniment To make matter more complex acute appendicitis may occur in the young won who is recently pregnant Difficult situations of this type require cons tation with the specialist and may necessitate diagnostic laparotomy inevitable abortion occasionally presents evidences suggesting *urinary fe* with chief complaints of frequency of micturition and dysuria

Faced with the problem of an inevitable abortion the wary prac tioner must be on the alert to the possibility that there has been previ illegal manipulation The patient may not only omit the history of s instrumentation or a visit to an abortionist but may deny that possibil under questioning If the circumstances are sufficiently suspicious vag oscopy is indicated and evidences of instrumentation are sought If t precaution is not exercised and a septic endometritis develops the on may be laid at the door of the innocent practitioner

Complete Abortion—When abortion occurs within the *twelve we period* the expelled tissue is preserved and reconstructed If the structu appear intact and clinical conditions are satisfactory, it may be possib to avoid operative procedure

Incomplete Abortion—After the twelfth week of gestation and in ear instances when fetus and placenta have not been demonstrably expelle the practitioner must conclude that the products of conception have bee incompletely evacuated There may be persistence of a *bloody vaginal di charge* the *cervix* remains soft and patulous and the *uterus* continues be enlarged Immediate infection and serious hemorrhage are invited b these circumstances and later aftermaths include sterility

Missed Abortion—Retention of the products of conception after th death of the embryo occurs in approximately 2 per cent of all instance The symptoms and signs at the onset are similar to those of threaten or inevitable abortion however the uterus remains enlarged and there a persistent *brownish vaginal discharge* The attendant signs of pregnanc

The usual end result is an *abortion* indicated by the onset of profuse *uterine bleeding* and the appearance of *grapelike cystic masses* in the vaginal discharge Occasionally *uterine perforation* occurs with the rapid onset of *peritonitis* or *collapse* from intraperitoneal bleeding On examination of a patient with a hydatid mole the cervix may be found to be dilated by a protruding mass of *cysts*

Diagnosis.—The diagnosis of hydatidiform mole is not difficult if the condition is suspected and vaginal discharge is carefully studied for typical cysts Very rarely the condition is suggested by a *reddish blue nodular transplant* on cervix or vaginal wall The biologic tests for pregnancy are usually more strongly positive than normal due to the excretion of excessively large amounts of chorionic gonadotropin formed by living chorionic tissue



Fig 66 —Hydatidiform mole

Treatment—The uterus is emptied as soon as the diagnosis is made Great care is taken not to perforate the thinned uterine wall It is best to remove the smallest amount of tissue compatible with safety and to pack the uterus for two or three days The remainder of the mole usually comes away upon removal of the packing Following removal of the mole the patient is carefully observed Monthly pregnancy tests are performed as a check upon the completeness of the removal of the mole and to detect the development of a chorionepithelioma The persistence or return of a positive pregnancy test is an indication for diagnostic curettage

CHORIONEPITHELIOMA

The chorionepithelioma is a *malignant neoplasm* derived from chorionic tissue It may be observed after hydatidiform mole abortion full term

may be packed for twenty four to forty eight hours unless the surgeon feels sure that the curettage is complete If there is danger of infection prophylactic anti infective therapy is initiated by topical or oral sulfonamide (p 88) and/or intramuscular injections of penicillin

Missed Abortion—The missed abortion is dealt with in the manner of an inevitable abortion (p 2653)

Septic Abortion—The development of a septic condition within the uterine cavity requires institution of the measures used in the treatment of *puerperal* and *postabortal endometritis* (p 2606) *Prophylactic therapy* with sulfonamide or penicillin and streptomycin is begun if it becomes known to the practitioner that his patient has visited an abortionist or if there is hazard of impending infection after therapeutic or spontaneous abortion

Habitual Abortion—Habitual abortion is treated by the discovery and elimination of systemic and local predisposing factors (p 2653) Under any circumstance intramuscular injections of 1 mg of progesterone daily are worthy of trial and wheat germ oil may be given orally The woman is put to bed before the expected time of abortion and kept there as long as is possible or convenient

HYDATIDIFORM MOLE

Hydatidiform mole is a rare abnormality of the *chorionic tissue* marked by a proliferation of epithelial cells vascular obliteration and the formation of grapelike cysts It is quite rare occurring once in 3000 pregnancies About 15 per cent of hydatid moles give rise to malignant *chorionepitheliomas* (p 2655) The etiology is unknown but probably resides in a defect of the ovum since in some twin pregnancies one ovum may show hydatidiform changes while the other develops normally

Pathology—The hydatidiform mole shows overgrowth of component parts of chorionic tissue Epithelial proliferation is usually marked Langhans cells form masses that protrude through syncytium into the vascular spaces and sinuses that surround the villi Perforation of the uterus may occur with the production of peritonitis and intraperitoneal hemorrhage; syncytial cells may invade the vascular sinuses with hematogenous dissemination to pelvic organs and lungs These metastatic foci do not necessarily denote malignancy

The embryo dies early and is usually completely absorbed Chorionic villi fill the uterus and form large masses which resemble "white currants in red currant jelly" As a rule, the mole grows for three to four months after the death of the embryo and the uterus reaches the size of a five-months pregnancy There is usually striking enlargement of both ovaries due to multiple luteum cysts containing yellow serous fluid These undergo involution upon removal of the mole

In rare instances only part of the chorion is affected by cystic degeneration The fetus lives for a considerable period but abortion is inevitable at five or six months

Clinical Manifestations.—The essential clinical findings of the mole are early irregular *uterine bleeding* (p 2665) and serous *vaginal discharge* The uterus grows rapidly and is often larger than indicated by the history Thus if the patient is seen during the third month of her calculated pregnancy the uterus may be enlarged to the size of a six months gestation As time passes the difference between the calculated duration of pregnancy and the size of the uterus becomes less marked In fact at six months the uterus is actually smaller than its expected size The patient does not feel fetal movements and the physician is unable to palpate fetal parts The patient may complain of *lower abdominal pain* *malaise* and *anorexia*

pregnancy or ectopic gestation The male homologue is a teratoma of the testis (p 2442)

Pathology—The growth is composed of solid masses of *anaplastic epithelial elements* whose cells are large and polyhedral in shape The mass may not be large The uterus is often normal in size and shape so that the primary intra uterine growth is difficult to detect

Metastases occur early and are widespread The dissemination occurs via the blood stream to sites in lungs brain, kidney spleen vagina and ovaries A vaginal metastasis may be the first sign of the existence of the tumor As with hydatidiform mole luteum cysts of the ovaries are common findings

Clinical Manifestations—The clinical picture is one of *recurring uterine bleeding* (p 2565) after removal of a hydatidiform mole or the termination of pregnancy In rare instances the initial clinical findings are *pulmonary* or *intracranial* due to metastases The biologic test for pregnancy is strongly positive and the titer of chorionic gonadotropin continues to rise Characteristic tissue is often obtained on *diagnostic curettage*

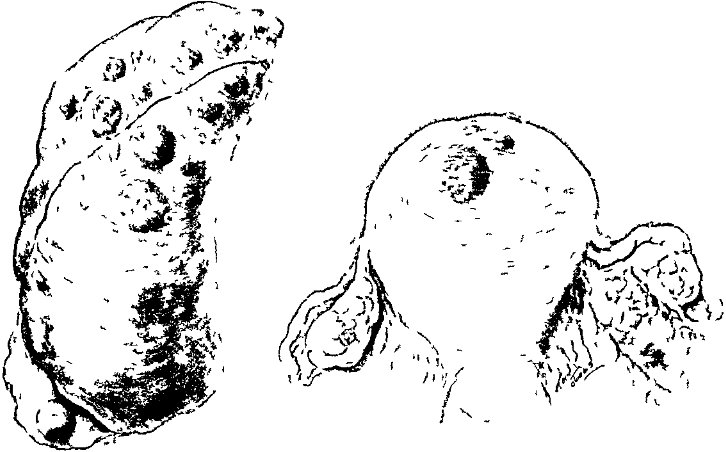
Treatment—Treatment offers little promise If there are no demonstrable secondary deposits a *radical panhysterectomy* is indicated In the presence of metastases surgery is regarded as futile and high voltage deep *roentgen therapy* may be instituted as a measure of desperation In rare instances metastases have been known to regress upon removal of the parent tumor

ECTOPIC PREGNANCY (EXTRA UTERINE PREGNANCY)

Implantation and development of the fertilized ovum outside the uterine cavity is estimated to occur once in every 300 pregnancies Several types of ectopic pregnancy are recognized according to the site of implantation In *ovarian pregnancy* the ovum is attached to the ovary in *tubal pregnancy* placentation occurs in some portion of the fallopian tube the *interstitial* type is marked by implantation in the portion of the tube lying within the uterine wall in the *abdominal* variety the ovum is at first free in the peritoneal cavity and later becomes attached to the abdominal wall or viscera

Etiology—Tubal gestation is produced by delay in the normal migration of the fertilized ovum through the fallopian tube Fertilization normally occurs in the outer third of the tube (ampulla) After six or seven days the ovum aided in its passage by the ciliated tubal epithelium and by tubal peristalsis enters uterus and burrows into endometrium (nidation) The invasive action of the ovum is due to the presence of *trophoblasts* whose development is synchronized with migration so that they penetrate maternal tissues after entering the uterus Should the ovum be delayed or obstructed in its passage through the oviduct the development of the trophoblast causes nidation to occur within the tube

The causes of ectopic pregnancy are *congenital mechanical* or *hormonal Infantile or hypoplastic tubes* are narrow and elongated with little peristaltic activity and poorly developed cilia the progress of the ovum is slow and its journey is prolonged even though there is no gross demonstrable defect Much more commonly tubal defect results from the pre existent *salpingitis pelvic inflammatory disease endometriosis* or the presence of a small *tumor* Following salpingitis the ciliary action of epithelium is defective and adhesions are produced between mucosal folds Chronic pelvic inflammatory disease such as that due to tuberculosis and puerperal



A B

Fig 664—Chorio-epithel oma of the ute us *A* The metastases in the lungs were b ill antly colored as llustrated The mult olo e l un bil cated tumor nodules were of rather soft consisten y va ied up to walnut e and on inci on revealed dark b own l mo l agi necrotic surfaces *B* Uterus viewed from beh nd The colo s are almost perfectly produced H gar e gn was trongly po t ve Not tl e n tastatic nodule in the right broad l gam nt The opened uteru conta ned an egg d d ep red son l at pedun ulate l l mo l agic tun o n as

Curt s in Surgery Gynecology a d Ob t tr Ju 1932

On examination the uterus is somewhat enlarged and soft The characteristic feature is a soft sensitive *sausage shaped mass* in the cul de sac or in one fornix (Wharton) enlargement of the ovary also may be noted The condition is easily confused with normal pregnancy associated with a corpus luteum cyst an ovarian cyst or chronic salpingitis The examination of the patient with a possible unruptured tubal gestation is conducted with great gentleness since rupture may be precipitated by palpation

The Stage of Tubal Rupture—Rupture of a tubal pregnancy is frequently the first recognizable event in the course of an ectopic gestation Typically there is a sudden episode of severe *lower abdominal* or *pelvic pain* attended by *fainting* or *collapse* In many instances pain radiates to



Fig 66 —Photographs of 2 cases of tubal pregnancy Above in the process of tubal abortion Below tube about to rupture

the shoulder or intrascapular region and is associated with *nausea* and *vomiting* simulating an *acute biliary colic* (p 2000) or a *perforated peptic ulcer* (p 1790)

Collapse is a constant clinical feature It may occur shortly after the onset of the severe pain or it may come on within a few hours as the result of intraperitoneal hemorrhage In the latter circumstance collapse is preceded by weakness nausea cold sweats and pallor

The examiner recognizes that the patient is in *shock* the abdomen may be diffusely rigid or there may be signs of peritoneal irritation in one of the lower abdominal quadrants Occasionally there are evidences of intra abdominal bleeding such as bluish discoloration about the navel (*Cullen's sign*)

Pelvic examination reveals fairly typical findings the *cervix* is exquis

or postappendiceal peritonitis, results in the formation of tubal kinks and distortions with resultant narrowing of the lumen

In the absence of structural change to explain tubal localization of the ovum it has been suggested that the disturbance resides within the ovum or in some *hormonal defect* In some ova the erosive action of the trophoblast may develop prematurely while the ovum is still within the tubes there is also the possibility that functional abnormalities of the *corpus luteum* cause extra uterine implantation

Pathology—Variations in the site of implantation lead to the several types of tubal gestation Most frequently the ovum lies in the *ampulla* the wide distal portion of the tube *isthmal* localization is not uncommon but the *interstitial* type is rare The site of nidation determines the sequence of future events and the subsequent fate of the ovum Bilateral tubal pregnancies and simultaneous tubal and uterine gestations are very rare

After nidation the ovum behaves as it would in the uterus By the cytolytic action of trophoblasts it penetrates mucosa and burrows into the muscle layer of the tube The tubal mucosa is unable to form a decidua and large tubal blood vessels are eroded with resultant extravasation swelling and tension

As the ovum grows the thin tubal muscularis becomes stretched and reduced to a narrow capsular layer The subsequent events may be tubal *abortion* tubal *rupture* or rarely a gradual disintegration and absorption within the tubal wall and the formation of a *tubal mole*

Tubal Abortion—Tubal abortion is the commonest mode of termination and usually occurs before the third month in the *ampullary type* Hemorrhage loosens the ovum and causes it to be swept into the peritoneal cavity there may be profuse bleeding into the peritoneal cavity leading to the formation of a large *hematocele* or the bleeding may be confined to the tube producing a *hematosalpinx*

Tubal Rupture—Tubal rupture is less frequent and is seen most commonly in association with *isthmal localization* It occurs relatively early in the second month or in the early part of the third The precipitating factor may be slight trauma caused by coitus straining at stool or bimanual examination The ovum frequently is extruded into the peritoneal cavity and rarely between the layers of the broad ligament In the interstitial type rupture may occur into abdominal or uterine cavities and is attended by marked *hemorrhage* due to the great vascularity of the tubo uterine angle The ovum usually dies at the time of tubal abortion or rupture In a few instances however it may live for a considerable period after re attachment within the abdominal cavity

Pelvic Hematocele—Intraperitoneal hemorrhage is a feature of rupture irrespective of the site The resultant *pelvic hematocele* may be the only residuum of an unrecognized rupture Unless infection of the hematocele gives rise to a *pelvic abscess* recognition of the lesion and its precursor may be difficult to diagnose

Clinical Manifestations—The clinical manifestations of a tubal gestation are dependent upon the phase in which the patient is observed The earliest stage is that of *growth* this is followed by the urgent symptoms of *tubal rupture* or *abortion* and finally the less tempestuous phase of the *pelvic hematocele* The entire sequence is not observed in any given patient If the first stage is recognized operative interference cuts short the development of later phases

The Stage of Growth—Early tubal pregnancy is associated with few characteristic symptoms or signs The patient suspects a pregnancy because of the *missed period* There may be confirmatory symptoms such as soreness and swelling of the breasts and slight anorexia Cramplike *lower abdominal pains* are often present but are usually disregarded because of their mildness *Vaginal bleeding* may occur as during the early months of a normal pregnancy or upon the death of the fetus but many patients are completely unaware of the existence of the pregnancy

nancy is the *positive Aschheim Zondek or Friedman test* as long as the fetus and its chorionic elements are viable A widely fluctuating leukocyte count is suggestive of recurrent hemorrhages red blood counts and hemo globin concentrations are reduced in proportion to the amount of concealed hemorrhage The *sedimentation test* is within normal limits in contrast to the reading in salpingitis (p 2608)

Treatment —Surgical procedure is limited to essentials The pregnant tube is removed after clamping and ligating ovarian and uterine ends of

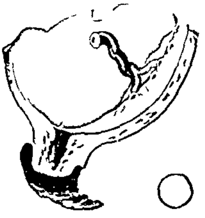


Fig 666 —Placenta *praevia marginalis*

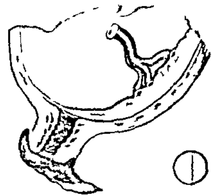


Fig 667 —Placenta praevia lateralis

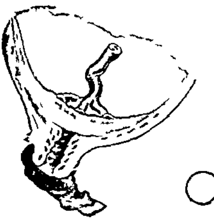


Fig 668 —Placenta praevia totalis or centralis

the tubal circulation The abdomen is closed quickly without drainage and without regard for the presence of blood clot in the pelvis *Blood transfusions* and *intravenous fluids* are indicated before during and following the operation Shock is combated by plasma infusions (p 3778) which may have to be given in the home before transportation to the hospital

PLACENTA PRAEVIA

Placenta praevia is a *low implantation of the placenta* so that it en croaches upon the internal os This condition though uncommon is an

itely tender, especially on motion and a *doughy mass* or sense of resistance is felt in the cul de sac or a fornix

If rupture occurs more slowly the symptoms are less acute and are marked by recurrent attacks of sharp *lower abdominal pain* intermittent *vaginal bleeding* and gradually increasing *weakness malaise* and *anorexia* The clinical picture may be difficult to differentiate from *threatened abortion* (p 2651), *acute salpingitis* (p 2608), twisted *ovarian cyst* (p 2577) or *acute appendicitis* (p 1881)

The Stage of Tubal Abortion—The symptoms and signs of tubal abortion differ only in degree from those of rupture As a rule there is no great increase in the severity of the pain present during the stage of growth the degree of peripheral circulatory failure is dependent upon the amount of blood loss The physical findings include lower abdominal tenderness and rigidity, a soft tender cervix and a doughy mass in the posterior fornix The differentiation between tubal rupture and tubal abortion is an academic exercise since surgical intervention is required for both

Pelvic Hematocele—Following tubal abortion or rupture of a tubal pregnancy a collection of blood becomes walled off in the pouch of Douglas, in one of the fornices or between the layers of the broad ligament The acute phase of rupture or abortion may have passed unrecognized but the hematocele leads to *pelvic pain urinary difficulties* and *constipation* Infection of the clot produces a *pelvic abscess* whose presence is denoted by a fluctuant ill defined mass An older collection may feel like a solid tumor due to the formation of dense connective tissue

Ovarian Pregnancy—Ovarian pregnancy is an extremely rare condition The clinical findings are similar to those in tubal pregnancy At operation the fallopian tubes show no gross or microscopic evidence of pregnancy The nature of the ovarian lesion is not always easy to determine and the exact diagnosis may require microscopic examination

Abdominal Pregnancy—A primary abdominal pregnancy in which the ovum is fertilized while free in the pelvic cavity is very rare Abdominal pregnancy usually follows tubal abortion In the secondary type the fetus develops among the abdominal viscera and the placenta becomes attached to tube ovary intestines or adjacent structures presenting a difficult surgical problem since removal may be impossible without serious hemorrhage and damage to these structures In many instances the placenta is best left in situ

During the early months the clinical picture is that of tubal pregnancy and most women are explored at this time Later the abdominal localization is suggested by *painful fetal movements* and the ease with which fetal parts are palpated and fetal heart sounds are heard Rupture of the sac may occur at any time causing severe internal hemorrhage

If pregnancy continues to term there is a short pseudo labor with expulsion of decidua from the uterus Fetal death usually occurs at this time but, if the condition is recognized promptly laparotomy may result in the extraction of a viable infant

Laparotomy is required as soon as the diagnosis is suspected The technical details are great due to the difficulty of removing placenta and gestational sac from the adjacent viscera If the placenta is firmly attached to bladder and intestines it must be left undisturbed to be absorbed

Laboratory Findings—The important laboratory finding of tubal preg

Ectopic Pregnancy	Missed period with irregular bleeding and mass in fornix (p 2657) Syncope at time of rupture Prepare for immediate laparotomy
Placenta Praevia	Relatively slight pain with irregular and profuse bleeding Uterine souffle heard in the region of the symphysis (p 2661) Cervix soft and dilated with placenta palpable Summon consultant obstetrician.
Premature Detachment of the Placenta	Vaginal bleeding with moderate to severe abdominal pain. Evidences of fetal distress (p 2665) Summon consultant obstetrician
Hydramnios	Marked abdominal enlargement. Fetal parts not felt. Fetal heart not heard (p 2668) Consider evacuation of uterus
After pains	If persistent after 36 to 48 hours look for evidences of subinvolution or retention of secundines (p 2717)

important cause of *uterine bleeding* during the latter part of gestation It is observed in about 1 per cent of maternity admissions to hospitals and its successful management requires consummate obstetrical skill and judgment.

Etiology—Normally the placenta is implanted high up on one of the walls of the uterus and impinges upon the fundus It may become implanted in the lower uterine segment and encroach upon the internal cervical os Several theories have been advanced to explain this abnormal localization One view maintains that as a consequence of deficient decidual blood supply the placenta spreads more widely than usual the defective decidual circulation is believed to be the result of a previous endometritis Another hypothesis is that part of the placenta arises from the decidual capsularis and comes to overlie the internal os Since the condition is encountered more frequently in multipara the theory of defective vascularization appears most tenable

Pathology.—Several anatomical varieties of placenta praevia are recognized, according to the site of implantation The most common (45 per cent of cases) is *marginal placenta praevia* in which the lower placental margin overlaps the cervix In *partial or lateral placenta praevia* (36 per cent of cases) the internal os is partially covered by placenta. The remaining 19 per cent are *central placenta praevia* with the placenta completely covering the internal os In a few instances the placenta is implanted in the lower uterine segment but does not reach the internal os This condition known as a *low implantation* of the placenta, tends to merge with the marginal type

Clinical Manifestations.—The characteristic clinical manifestation of placenta praevia is *painless bleeding* occurring in the last trimester The placenta separates and the fetus is endangered when its blood supply is jeopardized

Examination discloses that the consistency of the uterus is normal the presenting part is high and abnormal presentations are usual A well marked *uterine souffle* is typically present in the region of the symphysis Vaginal examination conducted under strict asepsis reveals that the cervix is soft and about one finger dilated and the irregular surface of the placenta is

DIFFERENTIAL DIAGNOSIS OF

The Special Causes of Abdominal Pain Associated with Pregnancy

The pregnant woman may suffer from generalized or localized abdominal pain exactly as n the non pregnant state (p 1748) Additional causes related to gravidity are listed below The practitioner confronted with this difficult problem of abdominal distress in the course of a pregnancy however must not limit his inve tigation to mere obstetric possibilities Acut appendicitis acute salpingitis twisting of an ovarian cyst, incarceration of a hernia and the like may prove to be the cause of the distress despite the pregnancy

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Onset of labor
Nausea and Vomiting	Soreness of abdominal muscles from per sistent retching
Hypertensive Toxemia of Pregnancy	Epigastric pain may precede convulsions Note hypertension albuminuria and edema (p 2638) Prepare to evacuate uterus
Pyelonephritis	Lumbar pain with pyuria Usually associated with pyonephrosis (p 2353) Consider intra venous and retrograde urography (p 2251) Start treatment with penicillin or sulfonamide (p 88)
Stretching of Uterine Ligaments	Bilateral lower abdominal pain especially in seventh or eighth month Examinations normal
Slipping Rib	Upper abdominal pain especially in seventh and eighth month Localized tenderness over costochondral junction Try procaine injec tions (p 3915)
Cholelithiasis	Localized tenderness in gallbladder region Get scout film and cholecystogram (p 2000) Advi e low fat diet (p 674)
Complete Abortion	With vaginal bleeding and dilatation of cervix
Incomplete Abortion	With vaginal bleeding dilatation of cervix but retention of products of conception Pre pare for curettage (p 2649)
Missed Abortion	With vaginal bleeding dilatation of cervix and persistent brownish vaginal discharge (p 2652) Prepare for curettage
Septic Abortion	With vaginal discharge dilatation of cervix, persistent foul vaginal discharge and fever (p 2606) Start anti infective treatment (p 106) and prepare for curettage
Hydatidiform Mole	Irregular uterine bleeding with serous vaginal discharge Uterus larger than expectation Grape like masses in vaginal discharge (p 2654) Prepare for immediate evacuation of uterus
Chorionepithelioma	Recurrent vaginal bleeding after mole or pregnancy (p 2655) Tissue obtained by curettage reveals characteristic histologic findings Prepare for panhysterectomy

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central implants which have a 5 to 10 per cent maternal mortality and a 50 to 60 per cent fetal mortality Early diagnosis and energetic treatment of hemorrhage do much to lower the hazard. Profuse postpartum hemorrhage is common and *puerperal sepsis* occurs with considerable regularity due to the low situation of the placenta and the presence of many nonthrombosed sinuses. The fetus may die as the result of premature asphyxia due to hemorrhage or attempts at extraction

Treatment—The treatment of placenta praevia is a difficult obstetrical problem At the onset of painless bleeding during the last trimester the condition is suspected and the patient is hospitalized at once Vaginal examination is avoided until the patient is in the delivery room fully prepared for immediate active intervention The particular procedure to be instituted depends on the individual findings and the judgment of the consultant obstetrician The non-operative program should include restoration of blood by transfusion (p 3[illegible]) prevention and active treatment of shock by intravenous fluids or plasma and prophylactic antibiotic therapy with sulfonamide or penicillin (p 10[illegible]) and streptomycin (p 104)

PREMATURE DETACHMENT OF THE PLACENTA (ACCIDENTAL HEMORRHAGE ABRUPTIO PLACENTAE)

Premature detachment of a normally situated placenta is a common and extremely serious complication of pregnancy In severe cases there is a *fetal mortality* of 100 per cent and a *maternal mortality* of 50 per cent Complete separation occurs about once in every 200 admissions to a maternity service Partial detachment on the other hand is frequent

Etiology.—The causes of premature separation are unknown The condition has been attributed to *trauma* but very seldom is a significant history obtained During labor it may be caused by tension on a short umbilical cord a very short cord may be stretched during descent of the fetus and a normal cord may become shortened by being wound around the body and neck Separation also may result from sudden reduction in uterine pressure when the membranes rupture in *hydramnios* and after the birth of one child in a multiple pregnancy The condition is not uncommon in patients with *hypertensive toxemia of pregnancy* and is perhaps related to the extensive placental infarction present in this condition Women suffering from toxemia have a severe degree of placental separation (abruptio placentae) four times more frequently than nontoxic patients The occurrence of an *acute infectious disease* may be followed by premature placental separation In most of the above mentioned conditions the factors leading to detachment are poorly understood There is usually however some degree of *retroplacental hemorrhage* which may act as a wedge

Clinical Manifestations and Treatment—Four distinct varieties of accidental hemorrhage are recognized by the obstetrician The manifestations and management are determined by the relative completeness of the separation and the presence or absence of apparent or concealed hemorrhage

Complete Separation in Early Pregnancy—The simplest variety of accidental hemorrhage is complete separation in early pregnancy with limitation of the change to the placental sites The placenta is pulled off the uterine wall and is expelled with blood clots while the main body of the womb is unaffected

felt instead of the smooth membranes In marginal cases the firm edge of the placenta is felt on one side In some instances the cervix is closed and the placenta cannot be felt directly, although the practiced hand has no difficulty in detecting a sense of intervening thickness between vaginal roof and presenting part

DIFFERENTIAL DIAGNOSIS OF

Special Causes of Vaginal Bleeding in Association with Pregnancy

The presence of vaginal bleeding during pregnancy is an alarming manifestation which requires immediate and intensive investigation In any instance of reasonable doubt concerning the origin of the hemorrhage the consulting obstetrician should be asked to see the patient after hospitalization See also Postpartum Hemorrhage (p 2717)

	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Physiologic	Continued menstruation for first two or three months Lochia rubra for first ten or twelve days following delivery (p 2715)
Abortion	With lower abdominal pain dilatation of cervix and complete or incomplete evacuation of uterus (p 2649)
Trauma	Following instrumentation for illegal induction of labor Following intercourse or vaginal examination Rupture of vaginal varix.
Ectopic Pregnancy	With palpable mass in fornix Prepare for immediate operation
Placenta Praevia	Relatively painless vaginal bleeding with dilatation of cervix and palpable placental tissue (p 2661) Admit patient to hospital and summon obstetrical consultant.
Premature Separation of Placenta	Moderate to severe abdominal pain with profuse bleeding Evidences of fetal distress (p 2665) Admit to hospital for immediate consultation with obstetrician
Hydatidiform Mole	Marked enlargement of uterus Passage of cysts in vaginal discharge (p 2654) Prepare to evacuate uterus
Chorionepithelioma	Persistent or recurrent vaginal bleeding following mole or pregnancy Get currettings for biopsy Prepare for panhysterectomy if tissue is characteristic (p 2655)
Hemorrhagic Diatheses	As in non pregnant Check hemogram bleeding and coagulation times and platelet count (p 3696) Consult hematologist for indications

The presence of a placenta praevia may be confirmed by *radiography* after the introduction of a radiopaque solution of sodium iodide into the bladder An abnormal space is demonstrable between fetal head and symphysis

Prognosis—Placenta praevia is an alarming complication of pregnancy which calls for specialist consultation and hospitalization The risk varies with the degree of completeness of the placenta praevia It is highest in

TREATMENT.—If the condition is recognized further separation is prevented by complete bed rest the administration of sedatives and intramuscular injections of 1 or 2 mg of progesterone In many instances with this expectant treatment pregnancy terminates successfully with the birth of a live infant However if the evidence of separation occurs while the patient is in labor the cervix must be dilated and the infant extracted by version forceps or cesarean section

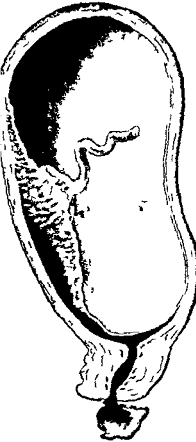


Fig 671 —Abruptio placentae External hemorrhage *

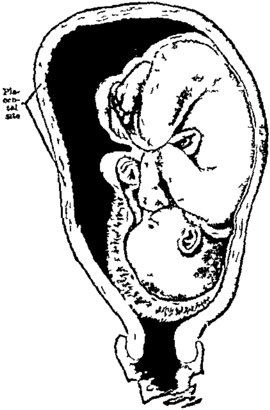


Fig 672 —Prolapsus placentae *

Complete Separation with Apparent Hemorrhage—At times the placental hemorrhage dissects the membrane free from the uterus as far down as the cervical os and is then revealed by free vaginal bleeding The uterine wall may show few or no changes The clinical evidence is furnished by the appearance of *marked hemorrhage* and evidences of *fetal distress* The presence of a placenta praevia is excluded by failure to demonstrate the latter on examination

TREATMENT —Since the baby is usually dead the efforts of the obstet

* DeLee and Greenhill, The Principles and Practice of Obstetrics, 8th Ed

The clinical manifestations are indistinguishable from those of an abortion and are marked by *vaginal bleeding lower abdominal pain* and *expulsion of the products of conception*

The treatment is similar to that of *abortion* (p 2653)

Incomplete Separation with Apparent Hemorrhage—Partial separation of the placenta may occur during the sixth or seventh month of pregnancy

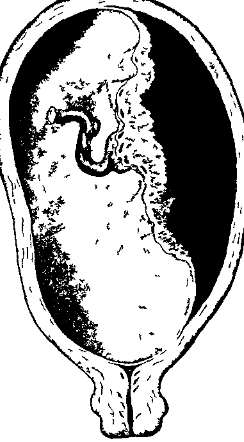


Fig 669—Abruptio placentae Internal or "concealed hemorrhage *

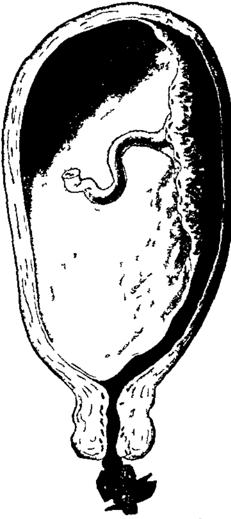


Fig 670—Abruptio placentae combined internal and external hemorrhage *

and the gestation continue to term The placenta reveals partially organized blood clot with slight degenerative changes

The clinical manifestations are those of *placenta praevia* (p 2663) There are varying degrees of *vaginal bleeding* and *severe lower abdominal pain* The fetal heart shows no embarrassment unless considerable separation has occurred Examination fails to reveal any evidences of placenta praevia

* DeLee and Greenhill The Principles and Practice of Obstetrics 8th Ed.

as excessive (*hydramnion*) while less than 300 cc constitutes *oligohydramnion*

HYDRAMNIOS (POLYHYDRAMNIOS)

Hydramnios occurs approximately once in each 200 pregnancies It may develop acutely in the fourth or fifth month but much more often it accumulates gradually up to term

Etiology —The factors which govern the secretion of amniotic fluid are unknown hence it is not possible to assign definite causes for the development of hydramnios nor to treat the condition by specific modalities

Among factors often associated with hydramnios are fetal and maternal disturbances Whether these are causes effects or common results of some more fundamental anomaly cannot be ascertained Among the coincidental *fetal* conditions are congenital malformations excessive size multiple pregnancy especially of single-ovum twins disturbances of the umbilical vein such as obstruction or narrowing abnormal insertions of the cord (velamentous battledore) hepatic cirrhosis and congenital cardiac lesions Associated *maternal* lesions include cardionephritic and hepatic conditions associated with edema and/or ascites and syphilis Finally hydramnios may be accompanied by an angioma of the *chorion* or evidences of inflammation of the *amnion*

Clinical Manifestations —The clinical manifestations of hydramnios are dependent for the most part on the rapidity with which the liquor accumulates In the acute variety usually encountered in the fourth or fifth month there are marked pressure symptoms followed shortly by abortion In the chronic type much more frequently seen the mechanical disturbances are well accommodated and actually may be symptomless

The maternal consequences of hydramnios include abdominal distention dyspnea tachycardia cyanosis and edema of the vulva and legs Examination reveals excessive uterine enlargement fluctuation and inability to palpate fetal parts or hear the fetal heart

In the acute variety abortion is almost invariable In the chronic form premature labor may be initiated with the birth of a deformed or dead child or with a multiple birth

Differential Diagnosis —On suspicion of hydramnios pregnancy tests are required together with x rays of the abdomen serologic tests for syphilis urine examination and a general physical examination If fetal parts are demonstrable it may be possible to identify a multiple pregnancy if they are not seen the patient is probably not pregnant and may have a simple ascites (p 1021) or a huge ovarian cyst

Course and Prognosis —Acute hydramnios is followed by spontaneous abortion with death of the fetus but preservation of the mother In the chronic type the maternal jeopardy rises since labor may be premature prolonged or complicated post partum hemorrhage may be severe and uterine emptying may precipitate acute forward failure (p 928)

Treatment —The management of hydramnio is most unsatisfactory In the acute type the problem is resolved by abortion In the chronic variety it is best judgment to terminate or precipitate labor as soon as maternal pressure symptoms become manifest

Attempts to perserve the pregnancy may be ill advised with sacrifice of both mother and child Since the baby is frequently short lived or de-

rician are directed to the arrest of hemorrhage by *packing* after *dilatation or incision of the cervix* Version extraction or craniotomy is performed with the utmost speed to limit the extent of the bleeding since every effort is now being directed toward saving the life of the mother After delivery the uterus is packed with gauze, *oxytocics* (p 2509) are administered a *transfusion* is started and *prophylactic therapy* is begun with sulfadiazine (p 88) or penicillin (p 106) and streptomycin (p 104)

Complete Separation with Concealed Hemorrhage (Uteroplacental Apoplexy Abruptio Placentae) —Complete separation of the placenta with concealed hemorrhage is attended by hemorrhage into the placental site The uterine wall shows extensive areas of bleeding it is hard and has a deep purple color especially beneath its peritoneal surface the muscle fibers are separated by edema and hemorrhage There are many hematomas on the maternal surface of the placenta and these may be the cause of the separation the broad ligaments are engorged and the kidneys often show a nephritic type of lesion Considerable free blood is often present in the abdominal cavity

CLINICAL MANIFESTATIONS —Uteroplacental apoplexy may occur in a patient who has been previously well but is more often observed in the woman who has suffered a *hypertensive toxemia* (p 2638) It produces a fairly typical syndrome with the sudden appearance of severe continuous generalized *abdominal pain* which rapidly increases in severity and quickly leads to *collapse* The *uterus* is felt as an extremely tender spastic mass which extends higher than normal in the abdomen its consistency is *cord like* *Fetal parts* cannot be felt and *fetal heart sounds* are inaudible Pelvic examination fails to reveal the placenta in the lower uterine segment and if the presenting part is gently displaced upward there is a gush of blood from the cervical os Repeated examinations disclose a gradual and irregular increase in the size of the uterus Urinary manifestations are almost invariably encountered the amount of urine may be scant and albumin is usually present anuria is often encountered particularly in fatal instances

TREATMENT —With abruptio placentae the patient is *hospitalized* and the *consultant obstetrician* is summoned for immediate operation As soon as shock can be controlled (p 928) fetus placenta and blood clots are removed as quickly as possible If the uterus fails to contract after direct and intravenous injection of oxytocics and the institution of massage it is removed by supravaginal hysterectomy During operation intravenous fluids and blood are administered Prophylactic therapy with sulfonamide or penicillin and streptomycin is highly advisable during the post operative period

If surgical intervention is impossible the cervix is dilated and the baby is delivered by version if alive The dead baby is subjected to craniotomy After delivery the uterus is firmly packed and the patient is treated according to the principles outlined above

THE AMNION

The amnion a thin membrane lining chorion laeve and placenta produces amniotic fluid in the early period of gestation At term the amount of the liquor is variable but amounts in excess of 2000 cc may be regarded

menace but is preventable by the instillation of 1 per cent silver nitrate into the eyes of the infant immediately after delivery (p 2749)

The *treatment* of gonorrhea in the pregnant woman differs in no way from that in the nongravid state previously described (p 2586) The patient should be confined to bed Follow up observations are continued for a longer period and at more frequent intervals in order to prevent contamination of the child and the medical attendants

Syphilis—An appreciable number of syphilitic females are able to impregnate though the majority of gravidities terminate in *stillbirths* Many women first learn of the presence of their infection through the birth of a luetic child Pregnancy apparently influences favorably the course of the syphilitic infection and keeps the manifestations at a subclinical level The child is less fortunate and if it does not come into the world prematurely as a macerated stillbirth it evidences manifestations of *neonatal lues* (p 2787)

Acquired syphilis during pregnancy is encountered with surprising frequency Many inconsiderate husbands philander as the result of the pregnant woman s lack of interest in intercourse or her relative unattractiveness Whether the syphilitic infection anteceded or followed impregnation vigorous specific treatment is required The earlier treatment is started and the more intensive the dosage the better the prognosis for the child One of the startling accomplishments of massive do e arsenotherapy of syphilis (p 342) has been the relative lack of toxicity to mother and child when treatment was given during pregnancy Penicillin gives promise of equal accomplishments with complete absence of significant hazard (p 340)

Tuberculosis—Pregnancy is a *dangerous complication* in tuberculosis (p 252) While some patients tolerate pregnancy with apparently favorable effects tragic consequences are often encountered Healed and latent foci may become activated and break down rapidly with the production of acute lesions The strain of parturition and the occurrence of the complications of pregnancy are poorly borne and lead to serious relapses *Infant mortality* is high due to general ill health and lack of resistance though congenital tuberculosis has never been demonstrated

The woman with active tuberculosis should practice *contraception* (p 2501) If she impregnates a *therapeutic abortion* (p 2649) is advised provided that there are no emotional or religious principles to the contrary If the woman insists on maintaining the pregnancy she should be required to fulfill the routine of a cure in her own interests and for the welfare of the child The trials of labor must be reduced to a minimum by *expert obstetrical assistance* Inhalation anesthesia is best avoided and is replaced by *spinal* or *caudal* varieties

The woman who has recovered from active tuberculosis and ardently desires a child may attempt gravidity if a minimum of two years has elapsed since the date of arrest She must be carefully watched during gestation At the first sign of reactivation a therapeutic abortion is advised or labor is induced prematurely

Cardiac Invalidism—Pregnancy is a *major complication* of cardiac disease because of the demands of gestation upon myocardial function Pregnancy adds to the work of the heart by augmenting cardiac output and

formed the hazard is the more unwise If labor is prematurely induced the amniotic fluid should be slowly removed to prevent malpresentations prolapse of the cord and shock

OLIGOHYDRAMNIOS

Oligohydramnios is the rare condition in which the bag of waters measures less than 300 cc Its etiology is unknown but its consequences include fetal deformities due to adhesions between amnion and fetus These may result in intra uterine amputations extroversions of abdominal viscera clubbed feet and leathery skin Labor is of en premature and protracted or complicated by abruptio placentae (p 2665)

AMNIOTIC ADHESIONS

Amniotic adhesions are most frequently encountered with oligohydramnion but may be found when the amount of fluid is normal The condition has been attributed to inflammation of the amnion and may result in fetal deformities or death

PREGNANCY AS A COMPLICATION

The problems incidental to pregnancy must be considered in the light of their effects upon pre existent chronic pathologic conditions and associated acute disturbances The physician is confronted with the dual problem of evaluating the effect of the pregnancy upon the complicating circumstance and of the effect of the complicating circumstance upon the gestation

Some of the associations have been discussed previously

Hypertension and Pregnancy (p 2638)
Chronic Nephritis and Pregnancy (p 2645)
Pyelonephritis and Pregnancy (p 2644)
The Anemias and Pregnancy (p 2644)
The Psychoses and Pregnancy (p 2647)
Chorea and Pregnancy (p 2647)
Peripheral Neuritis and Pregnancy (p 2647)
Sciatica and Pregnancy (p 2647)
Lumbosacral Sprain and Pregnancy (p 2647)
Subluxation of the Free Ribs and Pregnancy (p 2648)
Epilepsy and Pregnancy (p 2647)
The Dermatoses of Pregnancy (p 2648)
Phlebitis and Pregnancy (p 2648)
Varicosities and Pregnancy (p 2648)
Hemorrhoids and Pregnancy (p 3946)
Otosclerosis and Pregnancy (p 2649)
Acute Appendicitis and Pregnancy (p 2649)
Deformities of the Pelvis and Pregnancy (p 2853)
Organic Diseases of the Female Genital System and Pregnancy (p 2554)

The remaining material in the present chapter deals with pregnancy and gonorrhea syphilis tuberculosis cardiac invalidism the endocrinopathies rheumatoid arthritis and disease of the gallbladder

Gonorrhea —Women with *chronic gonorrhea* are usually sterile However fertilization may occur producing an acute exacerbation of the disease with a profuse cervical discharge *ectopic pregnancy* (p 2657) is not uncommon due to inflammatory strictures of the tubes *abortion* occurs frequency as the result of anatomic changes in the uterine endometrium

If gonorrhea is *acquired after conception* the infection remains localized to the lower canal since the cervical plug effectually blocks an upward extension Gonorrheal *opthalmia neonatorum* (p 1621) is a genuine

is made to restore circulatory dynamics before the relatively minor procedure is attempted A few days of bed rest may be very helpful probatory digitalization may be worthy of trial and mercurial diuretics (p 2257) assist in ridding the tissues of edema fluid if there is no contraindication to their use The practitioner is urged to refrain from the injudicious pre scription of many of the alleged cardiac stimulants (p 940)

Should the patient insist on continuance of pregnancy an effort is made to keep her in or near the hospital and preparations are made for cesarean section

The Management of Labor—If the cardiac mother progresses to term *heavy sedation* is required during the first stage of labor Delivery of the child is facilitated and hastened by every known obstetrical device *Inhalation anesthesia* carries a definite risk and *spinal anesthesia* has the disadvantage that it is apt to produce a lowering of blood pressure *Caudal anesthesia* (p 2680) appears ideally suited for the delivery of the pregnant cardiac The obstetrician must be prepared to do a *cesarean section* if there is any abrupt or continued deterioration of circulatory dynamics

Postpartum Care—*Cardiac collapse* may occur after the delivery of the child due to abrupt changes in circulation To prevent this sudden disaster many obstetricians place *sandbags* on the abdomen as soon as delivery is completed *Nursing* is best omitted

Postpartum rest must be prolonged beyond the usual period If the woman has suffered any significant deterioration in her circulatory status she is instructed that *contraception* is compulsory

The Endocrinopathies—Pregnancy bears a varied relationship to endocrine disorders Many women with endocrinopathies are unable to conceive *because of disturbances in the functions of ovary or uterus* *Certain diabetics* find that the fundamental metabolic disturbance is made worse by gravidity but patients with *adrenal cortical insufficiency* seem improved by gestation

Pregnancy is often associated with clinical evidences of *disturbances of* secretion in anterior pituitary thyroid parathyroid and insular tissues At times these manifestations are transitory and disappear upon the birth of the child but again they may be relatively permanent

Diabetes Mellitus—It is estimated that there are in the United States 100 000 diabetic women in the childbearing age and that about 1500 of these annually become pregnant In pre insulin days the problem of the diabetic woman was not to be contemplated with any degree of security Whereas the introduction of insulin provided a most effective weapon for the control of the disease pregnancy in diabetes still presents many unfortunate incidents The diabetic pregnancy is more apt to terminate in *stillbirth* estimates place the figures as high as six times that of nondiabetics The infant is apt to be *inordinately heavy and large* giving rise to difficulties in delivery birth weights of 8 pounds are common and some children weigh as much as 12 or 13 pounds The fetal overgrowth is attributed to hyperfunction of the maternal anterior pituitary gland *Congenital defects* seem to occur with great frequency *Hypoglycemia* (p 2779) and *asphyxia* (p 2766) are more often encountered in the neonatal period (p 2766)

The mother may show a striking gain in carbohydrate tolerance due

producing increase in the *volume* of circulating blood These changes are required by the greater nutritive demands of the uterus and other organs In addition to the burden of the greater load the heart functions under the mechanical disability of upward displacement of the diaphragm and limitation of respiratory excursion The sum total of these factors is a reduction in exercise tolerance particularly during the latter months of gestation Clinically this is manifest by the syndrome of *exertional dyspnea palpitation cardiac enlargement* and *accentuation of the second pulmonic sound* If the heart is further weighted down through edema and anemia *backward failure* (p 941) is almost inevitable particularly when the strain of labor is superimposed upon the already tottering structure The onset of a *hypertensive toxemia* (p 2638) adds the load of elevation of blood pressure which is poorly sustained

The Wisdom of Impregnation—If the physician is consulted concerning the advisability of impregnation in the cardiac patient his decision will rest largely on the *functional capacity of the myocardium* rather than the nature of the cardiac lesion Those women who have no more than a mild exertional dyspnea before impregnation may be expected to progress with reasonable comfort and minimum risk Those who have shown or still exhibit manifestations of *cardiac insufficiency* face a maternal mortality rate of 5 to 40 per cent depending almost entirely upon the degree of the decompensation There are many exceptions to these general principles regarding risk Occasionally the woman with minimum manifestations develops acute and fatal *pulmonary edema* during her pregnancy on the other hand sometimes a mother with marked evidences of backward failure and a lugubrious prognosis goes on to deliver her child without perceptible difficulty

In addition to purely medical aspects other practical points must be considered These include the intensity with which the woman desires her child her financial status her willingness and ability to remain in bed and be relieved of household burdens and the care of the child for the first few months after delivery the adequacy of her birth canal and the degree of cooperation that can be anticipated from her husband

Prenatal Care—The pregnant cardiac woman requires more than the usual prenatal care (p 2628) She is not permitted to gain an excessive amount of weight nor to develop a significant degree of anemia She must be prepared to spend most of the hours of the day in bed or at rest Her duties are reduced to absolute necessities and she must be prepared to go to the hospital for her delivery

The indications for digitalization are carefully weighed Their mature consideration requires review of therapeutic possibilities and toxic hazards of the drug (p 838) in consultation with the internist In instances of doubt and when the clinical course is unsatisfactory probatory digitalization is warranted provided that arrangements can be made for close observation and discontinuance of the drug upon the appearance of untoward effects Should patient and physician be convinced of a beneficial response maintenance doses may be continued through the puerperium

The Treatment of Complications—At the first evidences of pregnancy complications (p 2636) or congestive failure the cardiac mother must be removed to the hospital and prepared for therapeutic abortion An attempt

of postpartum necrosis of the gland or exhaustion following continued hyperfunction There is no presently available preparation by which these sequels can be prevented or treated

Adrenal Cortical Deficiency—Pregnancy is rarely seen as a complication of ***Addison's disease*** (p 1271) Improvement has been reported during gestation and this corresponds with the experimental observation that adrenalectomized pregnant animals survive longer than nonpregnant controls

The relationship of hyperfunction of the adrenal cortex to the hypertensive toxemia of pregnancy (p 2638) has aroused general recent interest Both conditions are characterized by hyperpiesis water retention and generalized edema Unfortunately there is no available method to deal with either derangement other than by limitation of sodium intake (p 682)

Rheumatoid Arthritis—One of the many fascinating observations concerning the obscure condition of rheumatoid arthritis (p 2910) is the improvement that is apt to occur when the afflicted woman becomes pregnant Unfortunately this boon must be weighed against mechanical disturbances caused by deformities during parturition

Gallstones—Pregnancy produces changes in *cholesterol metabolism* which often result in the deposition of ***concretions*** in the gallbladder and inflammation of the sac (p 2005) So common is this observation that a *low fat diet* (p 672) is mandatory during pregnancy Unfortunately despite best efforts cholesterol depositions occur indicating that the metabolic defect is probably of ***endogenous origin*** and possibly related to the structural similarity between the chemical constitutions of cholesterol and the ***steroid hormones*** (p 2513)

Rubella—Infants with congenital anomalies are born to all mothers who develop rubella (German measles) in the first two months of their pregnancy and to 50 per cent who develop the eruptive fever (p 417) in the third month The commonest anomalies are cataracts cardiac defects patent ductus arteriosus deaf mutism and microcephaly In consequence the wisdom of therapeutic abortion (p 2649) must be discussed when pregnancy is complicated by rubella

perhaps, to the overactivity of fetal insulin In contrast, many pregnant women exhibit a lessening of sugar tolerance and require additional insulin *Toxemia of pregnancy* which occurs more frequently in the diabetic strikingly depresses the metabolic status Estimates of the extent of the glycosuria may be complicated by the presence of *lactosuria*

The pregnant diabetic requires careful observation since her metabolic status is subject to change without adequate notice Those whose sugar tolerance increases may be precipitated into *insulin shock* (p 1241) by their normal dose of the drug By contrast other women whose sugar tolerance lessens may get completely out of hand and develop glycosuria hyperglycemia acidosis and coma

Because of the uncertainty of the clinical course the pregnant diabetic who is anxious to bear her child is given a trial of pregnancy She must understand that if metabolic control is lost *therapeutic abortion* is indicated as soon as her body chemistry can be restored to relatively normal conditions The woman who goes to term is to have *premature induction of labor* in view of the tendency of the infant to be overgrown An elective *cesarean section* in the eighth month is advised by those who desire to obtain a live child and eliminate the strain of labor for the mother

Hypothyroidism—The woman with hypothyroidism seldom conceives and if fertilization occurs abortion is common At term a *cretinous child* may be born unless substitution therapy with thyroid extract (p 1192) is begun early in the pregnancy and maintained throughout the period of gestation

Hyperthyroidism—While certain women with hyperthyroidism tolerate pregnancy without significant difficulty there is a real and genuine risk It is the better part of wisdom to advise preparation with iodine (p 1197) and thio uracil (p 1210) followed by *therapeutic abortion* After subsequent *subtotal thyroidectomy* (p 1214) the woman may safely conceive and carry on to term provided that she waits 12 to 18 months

Simple Goiter—The woman with simple thyroid enlargement is given iodides (p 1219) throughout her pregnancy This fulfills the dual purpose of preventing additional *hyperplasia* of her gland and the development of *cretinism* (p 1191) in her offspring

Hyperparathyroidism—Pregnancy is attended by a physiological hypertrophy of the *parathyroids* (p 2625) This change apparently occurs in the effort to prevent excessive lowering of the blood calcium due to the relatively enormous fetal requirements for bone forming minerals A relative or absolute degree of hyperparathyroidism is manifest clinically by evidences of *hypocalcemia* such as *paresthesias* cramplike *pains in the extremities insomnia* and *frank tetany* (p 723)

Hyperparathyroidism occurring in association with dietary deficiencies of calcium phosphorus and vitamin D may lead to the development of *osteomalacia* (p 2853) *osteoporosis* or *fetal rickets* (p 2850) These major disturbances are prevented by a high calcium diet provided by a quart of milk daily and accessory feeding of calcium lactate (p 604)

Acromegaly—Physiologic increase in the function of the anterior pituitary gland may in rare instances progress to obvious *acromegaly* (p 1156) Paradoxically, pregnancy may also produce *Simmonds disease* which is an anterior pituitary insufficiency that presumably arises as the result

5 Trans erse face or breech presentation (p 2 03)
6 Multiple pregnancy
7 Intrapartum and puerperal infection (p 2606)
8 The presence of insanitary and unsatisfactory home conditions
9 Pre-existent maternal disease particularly renal insufficiency tuberculosis rl umat c fever or circulatory difficulties
10 D lay in the progress of labor

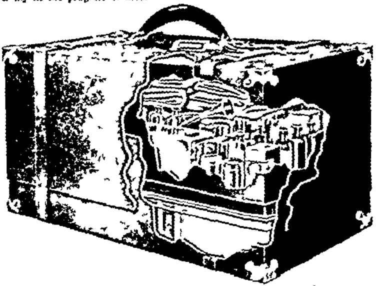


Fig 6 3—D Lee s operation telescope Portable steril zer telescoped at the bottom

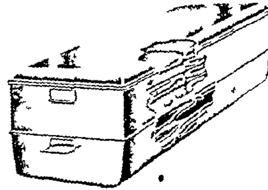


Fig 674—DeLee s portable sterilizer ready for sto e w th instruments in pan sl eets and towels in upper compartment The pan containing the instruments is telescoped n the tray f r pack ng

11 The necessity for contemplating the need for vers on multiple application of forceps breech extraction cer cal d latation cont nuous caudal anesthesia or cesarean sect on
12 D proport on betw n tl e s ze of the fetus and pel ic measurements
13 Incomplete or nfected abortions particularly with ex es ve bleed ng
14 Abnormalit es of the shape of the pelvis (flat, generally contracted transversely contra ted or irregularly contracted)

Contents of the Obstetrical Bag —The conduct of the home delivery makes it necessary for the practitioner to equip himself with sterile sup

CHAPTER 125

OBSTETRICS LABOR AND DELIVERY

In most communities except for larger cities the practitioner functions as an obstetrician usually delivering the mother in her home Throughout the United States however there is a growing trend to hospital obstetrics a practice of signal benefit to both mother and physician

Home Versus Hospital Obstetrics —The practice of obstetrics under institutional conditions spares the practitioner innumerable administrative details He saves precious time and energy otherwise consumed in travelling between his office and his patient s residence He is assured of trained assistance for anesthesia and delivery of the mother and for the care of the child He has more ready access to consultation with colleagues in the event of difficulties and he may fill in the waiting time caring for his other patients or resting away from the hovering presence of father and relatives

The mother profits from institutional care by her greater safety by removal from her household worries and the opportunity for more complete rest during the postpartum period The newborn child is afforded more expert and constant care during the particularly critical neonatal phase of its existence (p 2758)

Limitations of Home Delivery —The practitioner must recognize the limitations of home obstetrics He must be prepared and willing to call upon the obstetrical consultant when he encounters complications and to advise transference of his patient to the hospital when dystocia is anticipated or encountered

While the training of the individual and his available institutional facilities modify the indications for hospitalization the transfer of the mother from home to the well equipped obstetric ward should be given consideration under the following circumstances

1 Primiparity
2 Moderate to severe hypertensive toxemia (p 2638)
3 Placenta praevia and premature separation of the placenta (p 2665)
4 Contracted pelvis

Scopolamine.—Since the popularity of twilight sleep in obstetrics the supplementary use of scopolamine (p 3913) with opiate or demerol has achieved wide popularity It is the practice of most experienced physicians to give scopolamine hydrobromide in a dose of slightly more or slightly less than 0 3 mg (1/150 to 1/200 grain) with the first injection of opiate or demerol Whereas the opiate or demerol injection may be repeated at two or three-hour intervals as indicated scopolamine should be withheld for at least four hours if possible

The physician is reminded that scopolamine produces profound psychic changes usually in the nature of an amnesia with a certain amount of euphoria On occasions however patients exhibit idiosyncrasy and develop excitation or even delirium

Barbiturate.—After the effects of the initial hypodermic injection of opiate or demerol with scopolamine have been dissipated barbiturates are frequently given by mouth Sodium pentobarbital 0 4 gm (6 grains) may be taken in conjunction with a subcutaneous injection of scopolamine Patients who react unfavorably to large doses of barbiturates and become extremely restless excitable psychically disturbed and hyperactive may require restraint and should never be left unattended

After two or three hours pentobarbital may be repeated in a dose of 0 1 gm (1½ grain) but no more scopolamine is permissible except under unusual circumstances

INHALATION ANESTHESIA

For the second stage of labor complete anesthesia is desirable and is most satisfactorily administered in the home by the open cone method using ether At the beginning of a contraction approximately 45 drops of ether are poured on the mask and as the pain increases a few more drops are given With subsidence of the pain the mask is removed and the procedure is repeated until the head is about to escape from the vulva when complete surgical anesthesia is induced

As a substitute for ether in the home many physicians still use chloroform (p 3926) and ethyl chloride (p 3915) Despite the untoward and at times fatal reactions which accompany the administration of these preparations many experienced obstetricians report a lifetime of experience without having encountered difficulties The advantages of chloroform and ethyl chloride consist in more rapid induction of anesthesia and more rapid recovery

In hospital practice where anesthetic equipment is readily available it is almost universal practice to employ nitrous oxide with oxygen or ethylene or cyclopropane (p 4003) It is our opinion that these anesthetic agencies are the province of the specialist anesthetist The practitioner is warned against casual use by one who has had less than exceedingly rigorous training

HYPNOSIS

For the practitioner obstetrician familiar with its technic and dangers hypnosis may be employed alone or in combination with drugs in order to accomplish obstetric analgesia Reliable physicians with experience with this method report enthusiastically on its merit

plies instruments drugs antiseptics and suture material He must be in a position to meet the requirements for normal delivery and also for the common complications which may unexpectedly be encountered Many special obstetrical bags have been devised most of which contain a portable sterilizer that is divided into a lower section for carrying instruments and an upper section for sterile towels and sheets

Sterile Supplies—Two hand brushes gown and cap masks 4 rubber gloves 6 towels, 2 sheets 24 gauze pads 12 yards 2 inch packing gauze 1 package cotton sponges rolled gauze with tape cord tape flannel strip for cord cord dressing intravenous set local anesthesia set 4 vulva pads leggings hypodermic syringes assorted needles caudal anesthesia equipment (p 2682)

Instruments—Ether cone sphygmomanometer head stethoscope 4 sponge sticks 2 needle holders Simpson s forceps Tucker McClain forceps 2 artery forceps 2 mouse tooth forceps uterine packing forceps straight scissors bandage scissors 2 hemostatic clamps for cervical repair 6 hemostats rubber catheter glass catheter tracheal cannula 2 retractors perineal retractor 4 towel clips tenaculum forceps

Drugs—Ether C P Tincture of Green Soap Tincture of Merthiolate tablets of Ergonovine Hydrocrylate (Ergotrate H) 0 2 mg (1/300 grain) ampoules of Pitocin N N R capsules of Pentobarbital Sodium 0 1 gm (1½ grains) tablets of Bichloride of Mercury 0 5 gm (7½ grains) tablets of Morphine Sulfate 10 or 15 mg (1/6 or 1/4 grain) tablets of Scopolamine Hydrobromide 0.3 mg (1/150 grain) ampoules of Demerol (1 cc = 100 mg) container of 1000 cc of sterile 5 per cent dextrose in saline plasma ampoules of Menadione 2 mg (1/30 grain) 3 tubes of 0 chromic catgut with curved cutting needles ampoules of 0 to 10 per cent Procaine or Metycaine Hydrochloride for local anesthesia alcohol lubricating jelly ampoules of 1 per cent Silver Nitrate ampoules of Nikethamide (25 per cent) for emergency respiratory stimulation ampoules of Dilaudid 2 mg (1/32 grain)

OBSTETRIC ANESTHESIA

The pangs of childbirth may be ameliorated or completely dissipated by several methods of anesthesia used alone or in combination The modern practitioner and obstetrician employ basal anesthesia and analgesia general inhalation anesthesia hypnosis and local anesthesia by infiltration or the continuous caudal method

BASAL ANESTHESIA AND ANALGESIA

Irrespective of any other anesthetic system that is employed the majority of practitioners and obstetricians utilize sedative hypnotic and analgesic drugs particularly in the first stage of labor

Opiates or Demerol—There is unanimity of practice as to the preliminary administration of an opiate, such as morphine or dilaudid or the substitution for those of demerol (p 3863) It is common practice to give a primipara 10 to 15 mg (1/6 to 1/4 grain) of morphine sulfate as soon as pains are well established in regularity and strength and the cervix has dilated to the extent of 3 or 4 cm For those who develop excitation nausea or vomiting from morphine dilaudid 2 mg (1/32 grain) may be substituted There is increasing use of the newer synthetic demerol in doses of 50 to 100 mg (¾ to 1½ grains) It is our practice to favor demerol since it does not have a depressant effect on the fetus and apnea is not present at birth

Opiates should be withheld within four hours of the expected time of the delivery because of the depressant effect on respiration Demerol is not subject to this rule

end of the vertebral canal the sacral hiatus, present because of failure of fusion of the arches of the fifth and sometimes other sacral vertebrae is covered by the superficial posterior sacrococcygeal ligament

In more than 99 per cent of people the dura closes about the filum terminale not lower than the level of the second sacral foramen The distal part of the sacral canal is occupied only by the peridural space and its contents nerves loose areolar tissue fat lymphatics and blood vessels Below the closure of the dura it gives passage to the coccygeal and fifth fourth and third sacral nerves and their dorsal root ganglia The vessels in the sacral canal consist mostly of veins representing the lower end of the internal vertebral venous plexus They lie at the periphery of the canal and are most numerous anteriorly on the dorsum of the body of the sacrum

Fluids injected extradurally do not penetrate the meninges The subarachnoid space extends out along the spinal roots beneath the dura to the dorsal root ganglia It is therefore evident that in caudal analgesia the analgesic agent can act only on the nerve fibers distal to the dorsal root ganglia The third fourth and fifth such sacral ganglia lie a sufficient distance within the sacral canal so that the nerves distal to them are exposed to a strong action of the injected solution Above the third sacral the dorsal root ganglia lie progressively closer to their respective foramina the ganglia in the lumbar region lying partly and in the thoracic region wholly within the foramina This means that in the lumbar and thoracic regions the analgesic solution must pass out of the intervertebral foramina to bathe the spinal nerves distal to their ganglia

The level reached by fluid injected into the sacral canal through the sacral hiatus is dependent to a great extent on the volume of fluid employed When a total volume is given in fractional doses the level does not extend as high as if it had been given as a single dose The rate of injection is also a factor in height of analgesia and gravity can be made to play an important role Thus the effect usually extends higher on the side on which the patient is lying or the level reached with a given volume can be raised bilaterally if the patient lies on her back with shoulders lower than hips

In caudal analgesia a definite order not only in onset of effects but also in relative segmental levels is attained This order depends of course on two factors a difference in susceptibility of different types of nerve fibers to the drug progressive reduction in concentration of the drug at higher levels due to absorption of the drug or dilution with tissue fluid or both First to appear and highest to extend is hypalgesia without significant impairment of other senses As hypalgesia progresses to analgesia hypesthesia to touch appears

Motor loss occurs promptly and completely in the lower sacral nerves which are bathed by the solution for several centimeters in the sacral canal In the lumbar and thoracic nerves increased total dose and more frequent injections cause more intense motor effects at a given level

In addition to the somatic trunks the sacral parasympathetic nerves are blocked as well as the thoracolumbar sympathetic system to the level reached by the injected solution With parasympathetic block sensation from and control over the urinary bladder and rectum are lost With sympathetic block vasomotor tone is abolished to the level affected resulting in the familiar vasodilatation that accompanies lumbar sympathetic block The onset is the more striking in parturients in whom peripheral vasoconstriction is usually extreme

Contraindications —Contraindications to caudal anesthesia may be related to local or systemic difficulties They include abnormalities or malformations of the sacrum the presence of localized infection in the area extreme obesity or the presence of a draining sinus

Obstetrical contraindications include situations in which any intrauterine manipulation may be required such as transverse position an unengaged frank breech possible version of an after coming twin placenta praevia abruptio placentae and the unengaged head Under these circumstances the technical difficulties are increased since under caudal anesthesia the uterine muscles continue to contract rhythmically

Finally caudal anesthesia is withheld in patients who demonstrate sensitivity to the anesthetic agent severe anemia and in apprehensive patients with excessive anxiety

INFILTRATION ANESTHESIA

When for one reason or another inhalation anesthesia is contraindicated or cannot be accomplished low regional infiltration with 1 per cent procaine may be utilized though it is by no means as satisfactory as a parasacral nerve block or the continuous caudal injection developed by Hingson and Edwards

CAUDAL ANESTHESIA

Caudal anesthesia is a form of regional anesthesia in which insensibility to pain is produced by injection of a local anesthetic drug into the sacral canal through the sacral hiatus Because the medication is deposited extra

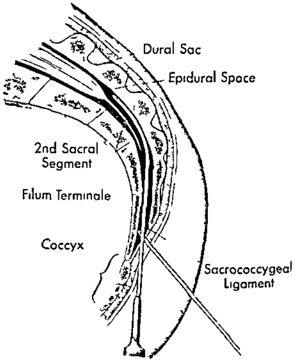


Fig 615 —Sagittal section of sacral region showing method of insertion of needle for caudal analgesia

durally caudal analgesia is sharply distinguished from spinal anesthesia (p 3922) in which the agent is placed beneath the dura in the subarachnoid space

Anatomy and Physiology Caudal analgesia makes use of the peridural space This space surrounds dura mater like a sleeve below the foramen magnum and separates dura from the ligaments and periosteum which form the wall of the vertebral canal The dura surrounding the spinal cord is closely adherent anteriorly to the bodies of the vertebras Posteriorly it is entirely free and laterally it is held only by the spinal nerves around each of which it sends an extension which fuses with the sheath of the nerve distal to the dorsal root ganglion For practical purposes then in the cervical thoracic and lumbar regions the peridural space exists laterally and posteriorly to the dura Through the fifty-eight intervertebral foramina it communicates with the deep cervical intercostal and retroperitoneal spaces At the lower

Courtesy of Eli Lilly and Company

lief from pain cooperation of the mother in efforts at expulsion shortening of the first stage complete relaxation of the pelvic floor so that the second stage can be terminated by low forceps extraction shortening of the third stage decrease in blood loss and the fact that the infant cries lustily immediately following birth

A report by Hingson (J.A.M.A *126* 1129) records 42 000 comfortable deliveries in an experiment spanning three years The average time for spontaneous breathing of the baby was 13 seconds and lusty crying occurred in 22 seconds Fetal mortality was reduced from 5 2 to 1 7 per cent and sixteen maternal deaths were recorded Of these six were due to obstetric complications and seven (1 in 6000) the misuse of the method of anesthesia

Apparatus —The requirements for continuous caudal anesthesia may be assembled from the supplies of several manufacturers

1 A reservoir ampoule containing sterile 1.5 per cent procaine or metycaine in 200 cc of Ringer s solution

2 Hose hub needles (2) for introduction into the two holed stopper of the reservoir ampoule The one is for ingress of air and the other is connected to the rubber tubing leading to the stopcock connected with the syringe

3 One length (2 ft) of rubber tubing to connect ampoule reservoir and stopcock

4 One stopcock to be fitted on syringe One outlet to be attached to the rubber tubing from the reservoir and the other for connection to the rubber tubing leading to the needle or cannula

5 One 20 cc syringe adapted for connection to the stopcock

6 One length (4 ft) of tubing to connect stopcock and adapter to needle or cannula

7 Special *needles and cannulas adapted for continuous caudal* analgesia to include two 19 gauge 2½ and 3 inch needles one 22 gauge 2 inch needles one 25 gauge ¾ inch needle and one metal sinker The needles *are of special malleable stainless steel The catheters are No 4 or No 5* ureteral catheters fitted to be threaded through 13 or 15 gauge special spinal needles or 18 gauge 5½ inch guide needles

Location of the Sacral Hiatus —The sacral hiatus is usually located 1½ to 2 inches above the tip of the coccyx If the ball of the middle finger of the left hand is placed at the tip of the coccyx the end of the thumb readily finds the U or V-shaped notch of the normal sacral hiatus If the sacral hiatus is abnormal or cannot be palpated an attempt at caudal injection should be made only after considerable experience with the technic

Although no two sacral hiatuses have exactly the same size shape or position the great majority are considered to fall within the limits of normal Some of the types of abnormality to be encountered are illustrated (Fig 677)

It is essential that only the bony landmarks be used in locating the sacral hiatus When a patient lies on her side the soft tissues and gluteal cleft are displaced downward by gravity If the gluteal cleft is used as a *guide the needle may miss the* sacrum and coccyx entirely entering the pelvis with consequent danger to mother and child However it has been observed that the sacral hiatus is usually at the level of the upper end of

Dangers—In our opinion the dangers of caudal anesthesia have been greatly exaggerated The untoward happenings are mostly the result of technical error and should not occur if the anatomy of the region is properly understood and if the operator has taken the trouble to obtain special training in the technic so that he is familiar with its limitations and contraindications

The hazards which may be encountered and which are preventable in almost all instances are the following

1 The needle may be inserted beyond the epidural space pierce the dura and enter the subarachnoid space Under these circumstances injection of the anesthetic into the spinal canal may result in the death of the mother This danger is avoided by preliminary aspiration before the drug

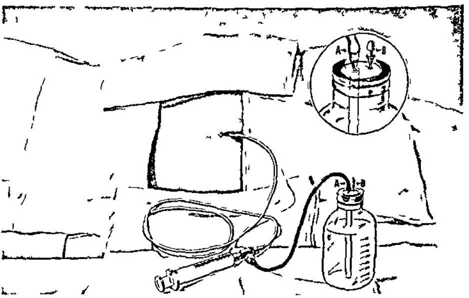


Fig 676—Assembly for administration of continuous caudal analgesia The needle attached to the short dark tubing through which the solution is to be withdrawn is inserted through the depression in the stopper centered above the glass tube (labeled A) Another needle is inserted through the other depression (labeled B) to allow ingress of air Hose hub needles such as those shown are not generally included with standard caudal analgesia apparatus *

is introduced A false entry is clearly apparent if spinal fluid enters the barrel of the syringe

2 The needle may pierce a blood vessel so that the anesthetic agent is injected intravascularly This danger is avoided by aspiration before injection If a vessel should be penetrated blood will enter into the barrel of the syringe and the technical error is easily avoided

3 The needle may miss the hiatus and be introduced through rectum vagina and even into the tissues of the newborn child This accident cannot occur if the operator is reasonably familiar with the anatomy of the region and recognizes the feel of soft tissue as against a hiatal entrance

Advantages—The advantages of caudal anesthesia include complete re

* Courtesy of Eli Lilly and Company

Two different instruments have been proposed a needle and a catheter Only those especially designed for continued caudal analgesia should be used They as well as the rest of the necessary equipment are obtainable from manufacturers such as Becton Dickinson and Company of Rutherford New Jersey

The insertion of the caudal needle or catheter is the most important single phase of the technic for upon the proper or improper location of this instrument depends the success or failure of the procedure and the absence or occurrence of some of the more serious complications

Needle Technic.—The needle technic was developed by Hingson and Edwards using special malleable stainless steel 19 gauge needles After the skin and subcutaneous tissues have been anesthetized the special caudal needle with stylet in place is inserted in the direction of the sacral hiatus from below at about a 45 degree angle with the skin As soon as the bevel of the needle pierces the sacrococcygeal ligament its reinforced metal collar is depressed through an arc of 1 to 3 cm and the needle is thrust slowly and evenly into the sacral canal in the midline where its bevel should lie inferior to the lowest extent of the dural sac In no case should the tip of the needle reach as high as the second sacral spine

After passage through the sacrococcygeal ligament the point of the needle should be directed toward the roof of the sacral canal It is believed that the chance for intravenous injection or rapid vascular absorption of the solution is greatly increased if the needle approaches too closely the vascular floor of the canal

The fingers of the left hand pressing on the needle through the skin are often of assistance in guiding the point to and through the sacral hiatus When bony resistance is met low in the sacral canal it is helpful to give the needle a half turn (180 degrees) In this way the bevel may be brought against the bone and the needle enabled to override it without injury to bone or needle

The stylet is removed and a short section of tubing with special adapter is slipped over the collar of the caudal needle A Luer Lok syringe half full of 1.5 per cent procaine or metycaine solution is securely attached to the adapter and gentle aspiration is performed If neither blood nor spinal fluid is obtained the needle is rotated 180 degrees and aspiration is again attempted As an added precaution a few drops of solution can be injected and aspiration repeated again turning the needle 180 degrees

Intravenous or subarachnoid injection must be avoided Doses of local anesthetic drugs which are perfectly safe on peridural injection may be fatal if given intravenously If blood can be aspirated the caudal needle is withdrawn a centimeter or two and reinserted more toward the roof of the sacral canal When it is certain that the needle is outside all blood vessels a few minutes should be allowed for closure of punctured vessels through clotting and then injection may proceed cautiously A few red cells need cause no alarm but repeated aspiration of pure blood should lead to abandonment of the attempt at caudal analgesia

Likewise failure to recognize a subarachnoid position of the needle may lead to massive and possibly fatal spinal anesthesia The special caudal needles are too short to reach the dura if the anatomy of the sacral canal and dura is normal About one patient in one or two hundred however

the gluteal cleft and that level may thus sometimes be helpful in the search for the sacral hiatus A more important landmark is the angle usually present at the sacrococcygeal joint If that joint is always located and if the needle is always inserted cephalad to it one can with certainty avoid missing the sacrum and entering the pelvis with the needle

When the hiatus has been found the middle finger of the left hand changes places with the thumb and marks the spot A skin wheal is then raised a half inch or more below (depending on the thickness of the sub

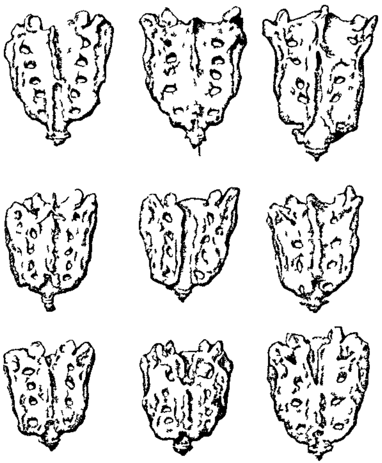


Fig 677 —Types of abnormal sacra commonly encountered (Redrawn from Conduction Anesthesia by George P Pitkin.)*

cutaneous tissue) using a 25 gauge needle and a syringe containing 1 5 per cent procaine or metycaine solution After skin anesthesia is obtained the solution is infiltrated to and through the sacrococcygeal ligament using a 2 inch 22 gauge needle

The patient is now ready for tests for the location of the needle if the single injection technic is to be used For continuous caudal analgesia however a special instrument must now be inserted through the sacral hiatus to remain in the sacral canal and carry the subsequent injections

* Courtesy of Eli Lilly and Company

with a caudal needle If the needle seems to be properly placed the 20 gauge needle is removed and the 15 gauge spinal needle is passed over the 18-gauge needle into the sacral canal and the 18 gauge guide needle is withdrawn

In slender individuals with large hiatuses the 15 gauge needle is used directly in the same manner as a caudal needle After it pierces the sacro-

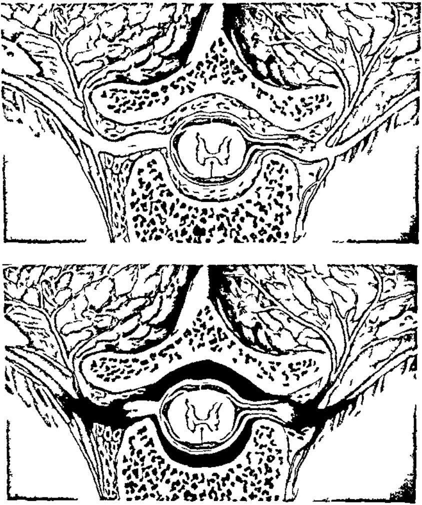


Fig 6 8—Transverse section in lower thoracic region showing site of action of analgesic solution on nerve trunks distal to union of dura mater and sheaths of nerve trunks *Top* Before injection *Lower* After injection The dark areas represent injected solution *

coccygeal ligament and touches bone the hub is depressed and the needle is pushed forward into the sacral canal As with the caudal needle it is well to avoid the vascular floor of the canal After the needle is in place the stylet is withdrawn

** Courtesy of Eli Lilly and Company*

will have a low lying dura which will be penetrated by the usual technic Penetration of the dura by the caudal needle is an absolute contraindication to the use of caudal analgesia There is reason to believe that *needle holes in the dura do not close at once* and it is possible for anesthetic agents subsequently deposited extradurally to pass through the needle hole and result in dangerously massive spinal anesthesia

Since one can occasionally puncture the dura or blood vessel and still not obtain spinal fluid or blood on careful aspiration a further precaution should be taken before the anesthetic dose is administered This consists in the injection of a test dose of 8 cc of 1 5 per cent procaine or metycaine solution If injected into the peridural space this quantity will produce a small area of analgesia (not more than 1 or 2 inches in diameter) in the coccygeal region (distribution of coccygeal and fifth sacral nerves) If injected into the subarachnoid space however the 10 mg of metycaine in the solution will produce a low yet safe spinal anesthesia Under these circumstances a much larger area of analgesia (3 to 6 inches in diameter) will develop rapidly and motor weakness may appear in the lower extremities within ten minutes It is important to note that in some cases a 1 5 per cent solution of procaine or metycaine may produce analgesia without motor loss even when injected subdurally Failure to obtain motor weakness in the legs is therefore not an infallible sign of extradural location of the needle

If the test dose is neglected and a massive spinal anesthesia results from the initial anesthetic dose the important thing is to assure the oxygen supply to the patient s brain until the drug is absorbed and metabolized If this is done there will be no sequels Metabolism of the drug usually requires forty to sixty minutes If the patient shows the slightest sign of anoxia or ceases breathing the administration of pure oxygen should be started immediately with tracheal intubation and artificial respiration if necessary One must guard against premature discontinuation of oxygen therapy Once an adequate oxygen supply is assured recovery of nerve function can be speeded by withdrawal of the spinal fluid containing the anesthetic drug This may be accomplished either through the caudal needle or from a lumbar puncture made with a large (at least 18 gauge) needle Drainage should be continued until the patient is out of danger Gready recommends compression of the jugular veins in the neck to increase flow or intravenous infusion of hypotonic (0 45 per cent) salt solution

Catheter Technic —Catheter technics are more complicated than that of a caudal needle A relatively large needle must be introduced into the sacral canal although it is not left there

The Adams Lundy Seldon technic uses a 13 gauge spinal needle and a No 5 ureteral catheter Irving employs a 15 gauge spinal needle and a No 4 catheter For obese patients or those with a small sacral foramen Irving inserts first after the skin and subcutaneous tissues have been anesthetized a special 18 gauge 5½ inch guide needle This needle is hubless and blunt but has a pointed stylet It is inserted in the same manner as a caudal needle except that it need not be rotated After it is in place in the sacral canal the stylet is withdrawn and a special 20 gauge tapered blunt needle and a syringe are attached Aspiration is made as

with epinephrine During labor 20 cc are usually adequate The need for supplementary injections can be most easily determined if the level of analgesia to pinprick is followed on the anterior abdominal wall

Obstetric analgesia should be complete when analgesia to pinprick on both sides of the abdominal wall reaches a level halfway between the symphysis and the umbilicus Analgesia should not be allowed to reach higher than the xiphoid When the level falls more than an inch or two below the umbilicus on either side a supplementary injection should be made Usually the level will be higher on the side on which the patient is lying If this difference amounts to more than one spinal segment the patient should be turned to lie on the low side before the injection is made If this does not result in equalization of the level on the two sides or if only hemianalgesia has been obtained from the beginning it is likely that the needle is not properly placed Sometimes the situation is corrected by rotating the needle through an angle of 180 degrees so that the position of the bevel is reversed It may be necessary to withdraw the needle and reinsert it in the sacral canal For best results it should lie in the mid line Thorough aseptic precautions should be taken before the needle *is* moved

Those not thoroughly familiar with the technic should make a rectal examination before moving the needle to be certain that it has not missed the sacral canal entirely and penetrated the rectum Such a needle is of course contaminated and should not be reinserted

To prevent contamination the plunger of the syringe should remain fully inserted in the barrel except while injections are being made During injection care must be taken not to touch the side of the plunger

Complications of Caudal Anesthesia —In general the incidence of complications in caudal analgesia appears to vary inversely with the experience and skill of the operator Serious complications seem to be limited to (*1*) reactions to the drug (*2*) undesirable effects due to injection into an improper location and (*3*) infection

To be effective in caudal analgesia the local anesthetic drug must be administered in quantities which although harmless if slowly absorbed produce toxic effects if released into the circulation too rapidly Reactions fall into three general types characterized respectively by (*1*) signs of central nervous irritation such as restlessness perspiration pallor palpitation nausea tremor excitement disorientation and in the more severe cases unconsciousness and convulsions (*2*) circulatory collapse or shock manifested by sudden fall in blood pressure bradycardia and in severe cases stoppage of the heart and (*3*) true allergic symptoms such as bronchospasm urticaria or angioneurotic edema This last type is apparently rare In 2000 cases of continuous caudal analgesia in surgery and obstetrics observed by Hingson Southworth and Edwards there were two cases of dermatitis attributed to metycaine The lesions appeared within twelve hours of delivery and resembled erythema multiforme They persisted for two days Both patients were under continuous caudal analgesia for more than six hours

Parts of the first two types of reaction may occur together There is some disagreement as to why one may predominate in a given case and some investigators question the validity of the distinction The severity of a reaction (and possibly the type) seems to depend at least in part on the rapidity of rise in blood level or the blood level attained or both Diff nt i d iduals *appear to ary gr atly in the r su ceptib l ty to the toxic effects of* l al anesthetic drugs

Direct ntrav n us inj t n s f course extremely dangerous There is evidence that sometimes following a bloody tap vascular absorption may be extremely rapid s mulating intra enou ject on even though no blood is obtained on careful aspiration For this reason the *vascular floor of the sacral canal is to be carefully* avoided in inserting the needle

In the early literature on single-injection caudal analgesia, intoxication from the anal

Whether or not the guide needle has been used a half filled syringe and adapter are attached to the 15 gauge needle and gentle aspiration is performed as with a caudal needle The needle is not however rotated When neither blood nor spinal fluid can be aspirated the test injection of 8 cc of 1 5 per cent procaine or metycaine solution is made While waiting the usual ten minutes to observe the effect of the injection the syringe and adapter may be disconnected and the No 4 ureteral catheter may be threaded through the 15 gauge needle The catheter is adjusted so that 3 or 4 inches lie beneath the skin depending on the thickness of the subcutaneous tissues The 15 gauge needle is then withdrawn over the catheter The catheter is never pulled back through the needle for fear of cutting it off against the bevel of the needle A 22 gauge blunt needle is now inserted into the catheter and aspiration is again performed with a syringe

Induction of Analgesia —After it is certain that the needle or catheter is not in a blood vessel or in the subarachnoid space the initial anesthetic injection is made For the single injection method no additional equipment is needed For the continuous method the free end of a special 4 foot rubber tubing is secured over the collar of the caudal needle or to the 22 gauge needle inserted into the catheter all air having been displaced from the tubing of the previously assembled apparatus with 1.5 per cent procaine or metycaine solution

With the palm of the left hand firmly pressed over the dorsum of the sacrum in order to feel any injection tumor the desired volume of solution is injected The injection is made at moderate speed and there should be no tissue resistance Too rapid injection by displacing the meninges and the contained spinal fluid too quickly may cause momentary headache dizziness or mild syncope

For labor and delivery analgesia must not fall below T 10 An initial volume of 30 cc will reach this level in the average woman In small women with narrow sacral canals and short vertebral columns 30 cc may reach several segments higher In others with large sacral canals and long vertebral columns the injection of as much as 20 cc additional may be necessary

Five minutes after the injection of the 30 cc the presence of saddle analgesia provides valid indication that the needle is in the sacral canal The rate of development of saddle analgesia is a useful guide to individual response

When it is certain that the needle is in the correct position and that analgesia is developing satisfactorily an antiseptic or sulfonamide ointment may be spread generously about its collar Hingson and Edwards prefer not to tape the needle in place With the catheter technic Irving seals the skin about the catheter with an adherent substance and pads it with cotton The catheter is then led around the flank and fastened in place over its entire course with adhesive tape

Supplementary Injections —The analgesia reaches its maximum level in twenty to thirty minutes and then begins to recede Recession is much slower if epinephrine has been added to the solution In continuous caudal analgesia supplementary injections will generally be needed every thirty to forty minutes without epinephrine or every sixty to ninety minutes

cases there were three cases of simple cellulitis and one peridural abscess the latter proving fatal on the thirtieth day postpartum This was the only maternal death in their series

Carlisle and Hall have reported deaths from infection following the procedure

In 900 surgical cases Southworth and Hingson observed mild cellulitis on two occasions Manalan attributed an attack of meningitis to the introduction of a catheter into the sacral canal Siever and Mousel encountered one peridural abscess in their first fifty cases Since altering the preparation of the patient s skin there has been no recurrence They emphasize the importance of strict asepsis throughout The skin is cleansed thoroughly with soap and water and scrubbed with alcohol and ether It is then painted with an antiseptic solution

Fall in Blood Pressure.—Several different factors may influence the blood pressure of a patient under caudal analgesia Pain itself may cause an increase in blood pressure which returns to normal when the pain is relieved Parturients and others who are in pain before the induction of caudal analgesia can therefore be expected to show a slight fall in blood pressure as the result of relief from pain

Blood pressure fall may also be produced by a toxic central action of local anesthetic drugs but this effect is apparently not seen with metycaine in the quantities ordinarily used unless very rapid vascular absorption has taken place in which case the fall will be immediate and may be extreme

Caudal analgesia extending to the thoracic segments blocks the lumbar sympathetic nerves and results in vasodilatation affecting the viscera and lower extremities There is thus an increase in the vascular bed which may lead to a fall in blood pressure Gready has pointed out that the larger changes in blood pressure are associated with analgesia extending to or above the umbilicus Southworth and Hingson however believe that not only the final height of sympathetic block but also the rate at which it is achieved influences the degree of hypotension If the block is made to ascend slowly the fall may be negligible whereas with rapid block it may be extreme The above is a physiological effect of caudal block which occurs without regard to the drug used

Southworth and Hingson are convinced that the blood pressure fall seen with caudal analgesia when absorption of drug is not a factor represents a different physiological change than that with spinal anesthesia Extreme fall in blood pressure during spinal anesthesia is usually accompanied by evidence of shock and anoxia Such is not the case with caudal block in the experience of Southworth and Hingson Lull has made a similar observation with regard to patients undergoing cesarean section under caudal analgesia namely that blood pressure may fall to extremely low levels without apparent change in the patient s condition These observations are at variance with those of Gready Lull also notes that the blood pressure returns to normal immediately after delivery of the child There is at present no satisfactory explanation for the reported difference between the effects of sympathetic block produced by caudal analgesia and by spinal anesthesia or for the immediate return to normal of the blood pressure following delivery of the child in cesarean section under caudal block

The incidence of hypotension in obstetric cases is variable Lull encountered a fall of more than 20 mm mercury in systolic pressure in only 8 per cent of about 900 cases Hingson and Edwards observed it in 90 per cent of their personal series of 11 0 obstetric cases Irving and co workers noted it in a considerably higher percentage Hingson and Edwards have found in confirmation of their opinion that the fall is a physiological result of the sympathetic block which occurs with caudal analgesia that raising the feet and legs of the parturient usually restores the blood pressure to normal within one minute With the fall they have not encountered fetal distress but Irving *et al* have This fetal distress characterized by a fetal heart rate below 100 is apparently due to fetal anoxia It should be treated by oxygen administration to the mother and elevation of her legs until a pressor drug is given and has become effective

Hingson and Edwards find specific treatment of hypotension per se unnecessary unless the systolic pressure falls below 90 mm mercury It is then their practice to give 25 mg ephedrine sulfate either intravenously or intramuscularly depending on the need of the patient and to include a pressor drug in the anesthetic solution subsequently administered either 20 mg of an ephedrine salt or 8 minims of 1 1000 epinephrine hydrochloride per 100 cc of solution It should be noted that when Ringer s solution is the vehicle for the mety[illegible] ephedrine [illegible] be used rather than ephedrine sulfate Ringer s solution contains calcium which is precipitated by sulfates

gesic agent was very common With improved technic and more suitable drugs the incidence has steadily fallen Reactions due to intravenous injection or to rapid vascular absorption occur immediately on injection or at least within a minute or two Reactions due to lymphatic and capillary absorption of relative overdoses of the drug usually begin twenty to forty minutes after administration Because of the rapidity with which local anesthetic drugs are destroyed in the liver late general toxic effects do not occur

Convulsions—Hingson and Edwards have observed convulsions twice in their series of 1150 obstetric cases In one 3 cc of solution were unintentionally injected into a blood vessel The patient complained of tasting the drug within ten seconds and had a mild clonic convulsion with disorientation within twenty seconds The condition cleared spontaneously within ninety seconds There was no change in pulse rate or blood pressure After rotation of the needle continuous caudal analgesia was carried on without further incident to delivery of a vigorous child The second patient received by mistake 50 cc of a 6 per cent solution of metycaine (a total of 3 gm) at a single injection She became disoriented and had a severe convulsion which was controlled by a barbiturate given intravenously There was complete block both sensory and motor (the latter undoubtedly due to the high concentration of the drug) to the level of the nipples for a period of six hours She was delivered *with outlet forceps of a baby that breathed spontaneously There were no neuro*logical or other sequelae

Gready has also reported convulsions following inadvertent intravenous injection of 25 cc of 1 5 per cent metycaine solution The reaction lasted about two minutes and disappeared spontaneously before any treatment could be given Following this the needle was reinserted and caudal analgesia was carried out successfully

Barbiturates in relatively small (sedative) doses appear to offer considerable protection against the convulsive type of reaction They should be administered an hour before caudal analgesia is induced Although barbiturates are more effective in prevention than in treatment they should be injected intravenously for reactions of the central irritant type Just enough is given to control the attack Overdosage should be avoided

Circulatory Collapse—A number of shock like reactions have been reported Gready and Hesseltine observed one in a toxemic patient with hypertension who was being prepared for cesarean section Siever and Mousel encountered three such reactions in 300 cases Hingson and Edwards have had no such experience in 1150 obstetric cases but Southworth and Hingson had two instances in 900 surgical cases Rapid vascular absorption is undoubtedly a large factor in the causation of immediate circulatory collapse Other possible factors are discussed in subsequent paragraphs

For circulatory collapse the barbiturates have little value Pressor drugs (epinephrine hydrochloride, 0.2 to 0 3 cc of 1 1000 or ephedrine sulfate 25 or 50 mg) cardiac and circulatory stimulants plasma and measures used to treat other types of shock should be employed Oxygen therapy is extremely valuable especially to prevent fetal anoxia it should be started immediately in all cases and not discontinued until recovery is complete

Of the various improper locations of the needle some are relatively harmless and some are dangerous Injection superficial to the sacrum is common and relatively safe although ineffective Subarachnoid injection may produce a dangerously massive spinal anesthesia Intravenous injection has been discussed Instances have occurred in which inexperienced individuals have missed the coccyx and sacrum entirely and introduced the needle into the pelvis Besides the danger of spreading infection by puncture of the rectum there is the possibility of severe injury or death to the child in obstetric cases if the fetal head is far descended Penetration of the pelvis by the needle can be avoided if caudal injection is attempted only when the bony landmarks can be felt and followed

Infection—As with any technic involving penetration of the skin infection is a possibility that can never be neglected Precautions against it must not be relaxed In his series of 141 cases Stoeckel encountered one superficial abscess due to organisms introduced through a misplaced needle by a contaminated fluid Identical strains were isolated from the analgesic solution and from the abscess Of this incident Stoeckel says frankly It was therefore plain that a double fault had been committed a gross breach of asepsis and technical ineptitude The second is excusable the first not

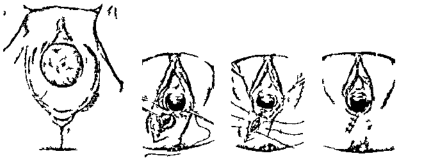
In the 10 000 cases of continuous caudal analgesia in obstetrics summarized by Hingson and Edwards infection occurred in 85 In 80 there was a simple cellulitis around the site of injection in 5 there was severe cellulitis or peridural abscess In their own 1150 obstetric

roots on the right side The latter are beyond the reach of a caudal needle thus excluding mechanical trauma from this source as a cause As might be expected there was no disturbance of bladder function since the second third and fourth sacral roots which supply the bladder were not affected.

Nausea and vomiting occurred one or more times during the course of labor and delivery in about 30 per cent of the obstetric cases of Hingson and Edwards Most of this they associate with the process of labor itself In about 5 per cent of the patients nausea and vomiting were associated with caudal injections and this incidence they attribute to the drug

Momentary headache or vague pressure sensations in the legs may be complained of *during injection They can be eliminated by slower injection Post analgesic headache and* other complications of spinal anesthesia as explained previously do not occur A few patients have had cramps in the legs as the effect of an injection was wearing off These are relieved by massage and a subsequent injection

During the latter months of pregnancy few women are comfortable lying on their backs because of pressure phenomena and because straightening the lumbodorsal curve causes pain Postpartum backache can be avoided by not having the parturient lie on her back for long periods while under caudal analgesia If patients must lie on their backs a small pillow or folded towel is placed under the lumbar spine Postoperative backache in both men and women can be prevented in the same way



A B C D

Fig 680—Episiotomy *A* Dotted line indicates usual extent and direction of incision which avoids possible extension into sphincter area Incision can be made on either side *B* Vaginal mucous membrane sutured with interrupted chromic 00 Deep interrupted chromic 0 sutures are used to approximate muscle *C* Interrupted chromic 00 at mucocutaneous junction held by clamps until subcutaneous sutures are completed *D* Skin closure completed by interrupted chromic 00 Note all suture ends are cut short to minimize irritation

Unilateral analgesia is sometimes seen When the patient is on her side it may be due to gravity The patient should be turned to lie on the unanesthetized side and given another injection

THE SURGERY OF OBSTETRICS

A thorough discussion of obstetrical surgery is beyond the province of the present section However so many practitioners and obstetricians employ *episiotomy and forceps deliveries as part of their routine* that a brief description of these procedures and a discussion of cesarean section have been included

EPISIOTOMY

While there is considerable difference of opinion concerning the advisability of routine episiotomy the authors recommend the procedure with prophylactic low forceps extraction in primipara and in multipara

Courtesy of Ethicon Suture Laboratories

Other Complications —In the personal series of Hingson and Edwards continuous caudal analgesia with metycaine did not increase the incidence of postpartum catheterization of the urinary bladder There are however reports of more or less persistent bladder dysfunction following the procedure In one series it was discovered that distilled water had been used as a vehicle in some cases Hypotonic solutions of any kind are known to be damaging to nerve tissue It seems likely that distention of the bladder itself may predispose to dysfunction Since vesical sensation is lost during caudal analgesia it is necessary to watch the bladder and empty it periodically if analgesia is continued more than two or three hours

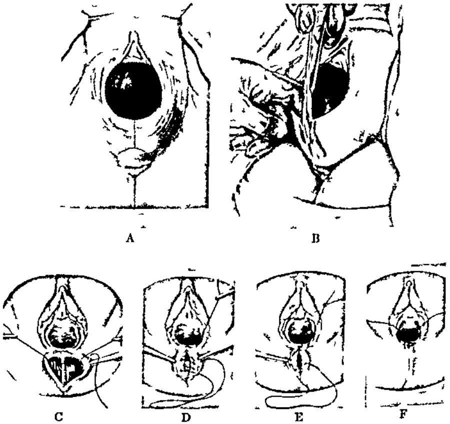


Fig 6 9—Episiotomy *A* Vertical line indicates normal extent of incision Arc line indicates elective extension avoiding anal sphincters *B* Incision is made in avascular midline area separating the levator ani muscles Tip-guard scissors used to avoid fetal trauma *C* Vaginal mucous membrane sutured with interrupted chromic 00 Levator ani muscles approximated with interrupted chromic 0 *D* Continued subcutaneous suture chromic 00 beginning at upper angle and extending full length of incision *E* Same suture used for subcuticular closure beginning at base of incision and ending opposite primary introduction *F* Subcutaneous subcuticular repair completed Note plastic result and absence of irritating external sutures *

Finally it has been suggested that residual bladder dysfunction may be due to trauma to the sacral nerve roots during introduction of the needle or needles This possibility is another reason for avoiding the floor of the sacral canal in introducing the needle

Diddle and Hill have reported thrombosis of veins in the sacral canal following introduction of a catheter with fatal pulmonary embolism No blood had been aspirated following insertion of either introducer needle or catheter

Hawkins reports a case of post analgesic nerve lesion attributed to nerve injury The fourth and fifth sacral roots were involved bilaterally and the first sacral and fifth lumbar

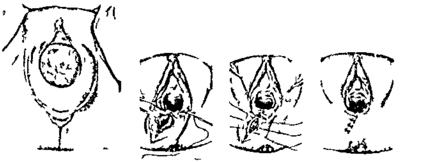
* Courtesy of Ethicon Suture Laboratories

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who have previously been delivered with these aids Multipara who have previously not required episiotomy rarely have need for the operation at a subsequent delivery

Types of Episiotomy —Episiotomy may be accomplished by midline or mediolateral incision The *midline episiotomy* separates the levator ani muscles If there is danger of the incision extending to involve the anal sphincter a lateral extension may be made The mediolateral episiotomy begins at or near the posterior fourchette and extends obliquely to the right, cutting through a portion of the right levator muscle

Technic —Bandage scissors are used for making the incision for the episiotomy the blunt tip serving to protect the fetal head Just before the operation Tincture of Green Soap is poured into the vagina for purposes of antisepsis and lubrication After the incision has been made low forceps are employed for extraction

Repair —Before the repair of the episiotomy is attempted vulva and incised tissues are painted with 3½ per cent Tincture of Iodine or 2 per cent acetone mercurochrome A small role of gauze with attached tape is introduced into the vagina to facilitate a clear field for suturing The vaginal mucous membrane is sutured with interrupted 00 chromic suture using square knots and leaving the ends short The levator muscles are approximated with interrupted 0 chromic suture a wide bite being taken into the muscle There should not be tension on the sutures Closure is completed by a continous subcutaneous subcuticular suture using 00 or 000 chromic (Fig 679)

With a mediolateral episiotomy the same technic is used as described for the midline incision After the mucous membrane sutures have been completed the incised levator muscle is approximated without excessive tension using one or more mattress sutures of 00 chromic Closure is completed by interrupted sutures through skin and subcutaneous tissues (Fig 680) After completion of repair the gauze roll is removed by means of the attached tape The uterus is palpated and any retained clots are gently expressed two sterile vulva pads are applied and held in place by a T binder

FORCEPS

Obstetrical forceps are used in order to grasp the fetal head and exercise traction for purposes of delivery Forceps are also employed to facilitate internal rotation in occiput posterior positions and in transverse arrest though manual rotation is preferable whenever possible

Indications —Forceps can be applied only after complete dilatation of the cervix They are indicated in delayed labor when there is uterine inertia as evidenced by weak or irregular contractions They may be required with abnormal resistance of the pelvic floor at the time when episiotomy is indicated They are used to effect more rapid delivery in the presence of maternal complications such as eclampsia hemorrhage and cardiac disease They may be indicated in the presence of a moderately contracted pelvis particularly the juxtominor and the funnel shaped pelvis though any marked disproportion calls for the performance of cesarean section

Dangers —The dangers of forceps involve injury to mother or child Vag

ina or uterus may be torn and bladder or rectum may be injured Im properly applied or excessive traction may produce compression of the brain of the child fracture of the skull cerebral hemorrhage facial paralysis and a wide variety of head injuries

To avoid dangers the following requirements must be met (1) The cervix must be fully dilated (2) the membrane must be ruptured (3) the presentation must be favorable (4) there must not be too great dis proportion between fetal head and parturient canal (5) the head must be engaged (6) the fetus should be viable

Preparation for Application of Forceps—Before application of forceps bladder and rectum are emptied and the patient is draped and prepared for delivery Preparations are made as for the episiotomy (p 2694) We do not favor ironing out the perineum as we are of the opinion that this practice causes undue mechanical stretching and tearing of the perineal fascia and muscles We prefer prophylactic episiotomy

Technic.—Forceps operations are designated as low mid high and float ing according to the position of the fetal head in relation to the pelvis When the head lies below the ischial spine and rests upon the pelvic floor the *low forceps* procedure is instituted When the head is at the level of

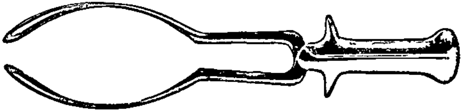


Fig 681—Simpson s forceps Made lon er and handle mod fied by DeLee

or just below the ischial spine a *mid forceps* application is practiced If the head has engaged and partially descended into the pelvis but its great est diameters have not passed the superior strait the procedure is termed *high forceps* Application to the floating head is no longer practiced *high and mid forceps should be undertaken only by the specialist*

For the performance of low forceps delivery when the head is on the perineum the operator notes that the sagittal suture occupies the antero posterior diameter of the pelvic outlet In anterior positions the lesser fontanelle is directed toward the symphysis in posterior positions the pos terior fontanelle is directed toward the cavity of the sacrum

The left blade of the forceps is introduced first and the right blade is introduced later It is important to determine that no part of the cervix is caught between blade and head Delivery is accomplished with the least possible traction If difficulty is encountered the forceps are unlocked to lessen the degree of cranial pressure and after one minute they are re locked and gentle traction is applied

Traction is made in the same direction as would be anticipated in a normal delivery At first the pull is downward and horizontal Later it is directed upward to simulate extension in the anterior positions As soon

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as the major portion of the head has emerged, the forceps are removed and care is taken to protect the perineum

CESAREAN SECTION

The practitioner obstetrician must be familiar with the technic and indications for a cesarean section since this procedure is life saving in many instances encountered in clinical practice

Indications—Absolute indication for cesarean section exists when the passage of the fetus is a physical impossibility as demonstrated by x ray Relative indications may be individualized and in general they are as follows

1 Contracted pelvis with a conjugate vera of less than 6.5 cm
2 Prolapse of the cord
3 Habitual death of the fetus during or just prior to labor
4 Habitual abruptio placentae (p 2665)
5 Abnormal placenta
6 Breech presentation
7 Face presentation
8 Fetal pelvic disproportion
9 Eclampsia (p 2640)
10 Placenta praevia (p 2661)
11 Abruptio placentae (p 2665)
12 In elderly primiparas
13 Cervical or vaginal stenosis (congenital or acquired)
14 Ovarian cyst
15 Fibroids
16 Healed vesicovaginal fistula
17 Cardiovascular disease with threatened or actual backward failure
18 Active or recently quiescent tuberculosis
19 Uncontrolled or severe diabetes
20 Previous cesarean section

Varieties of Operations—Different technical procedures are employed by different operators for individual reasons or because of maternal indications The classical conservative cesarean section is performed by making the incision into the fundus of the uterus the low section involves incision of the cervix either intraperitoneally or extraperitoneally The Porro supravaginal cesarean section is performed with amputation of the uterus the Portes operation is reserved for infected instances when the uterus must be brought outside of the abdominal cavity

Procedure—The indication for cesarean section should be confirmed by practitioner consultant and a responsible member of the family The operation requires removal to the hospital so that the patient may have the advantage of expert anesthesia and a trained surgical crew Full inhalation local spinal or continuous caudal anesthesia may be employed and the postoperative course is as for any other major surgical procedure (p 4004)

Blood typing and preparations for intravenous administration of plasma or whole blood are integral requirements before section

NORMAL DELIVERY

Normal labor (eutocia) as distinguished from abnormal or pathologic labor (dystocia) may be conducted by the practitioner obstetrician in the home of the patient or in the well equipped hospital The complications of obstetrics are specialist province and beyond the scope of the present discussion

Physiology—In normal parturition the factors to be considered include the powers by which the expulsion of the fetus is accomplished the condition of the birth passage the resistance it offers to the oncoming fetus and the nature of the passengers represented by fetus and placenta

The factors responsible for the onset of labor are unknown Various investigators attribute the onset to excessive distention of the uterine wall pressure of the presenting part on the lower uterine segments or increasing irritability of the uterus as the result of estrogen elaborated by ovary or placenta as pregnancy advances The gravid uterus certainly becomes increasingly sensitized to the action of posterior pituitary extract while progesterone exerts an inhibitory effect It may be that the endocrine balance is distributed or that a maturity hormone is secreted by the fetus

The Prodromes of Labor —The onset of labor is heralded by the sensation of lightening the onset of false pain the appearance of the show and the appearance of low backache and intermittent uterine contractions

Lightening —The sensation of lightening is one in which there is a sense of relief from pressure in the upper abdomen particularly after meals This is accompanied by greater pressure in the pelvis and a moderate increase in the frequency of urination Lightening usually occurs ten to fourteen days before delivery but it may be delayed until just before labor is initiated

False Pains —The false pains of labor occur during the latter weeks of pregnancy They consist of spasmodic short uterine contractions which are not particularly painful but merely give evidence of the greater irritability of the womb

The Show —Twenty four hours or more before the onset of labor there is usually a discharge of mucus which is often blood tinged This mucus plug known as the show is derived from the cervix and it is released as effacement of the cervix progresses during dilatation

Backache —The actual onset of labor is usually heralded by a low backache which is accompanied by intermittent uterine contractions recurring at regular intervals In primiparas particularly these may be false pains which tend to decrease and then stop completely for a few days before genuine expulsive contractions are experienced but in multiparas they are sufficiently important signs to have the mother summon her physician or apply for admission to the hospital

The Stages of Labor —The stages of labor are conventionally described as occurring in three phases In the *first stage* or period of dilatation there is the onset of regular contractions with complete effacement and dilatation of the cervix and rupture of the membranes The time of the rupture varies considerably In some instances the bag of waters breaks before the onset of labor but more frequently it occurs during the first stage Occasionally it does not rupture until after the presenting part has been delivered

The *second stage* of labor extends from the time of complete cervical dilatation until the delivery of the fetus It may be referred to as the stage of expulsion Finally in the *third or placental stage* after the delivery of the child the after birth and the membranes are delivered and the patient enters into her puerperium (p 2715)

Duration of Labor —There is a wide variation of the duration of labor In general the time is prolonged in primiparas but other factors which delay the process are the increased size of the fetus small pelvic measurements occiput posterior presentation the advanced age of the parturient and the nature of the uterine contractions In general however the first

stage in *primiparas* is 16 hours and the second stage 2 to 3 hours In *multiparas* the first stage is reduced to 12 hours while the second stage may last only 15 to 30 minutes

Mechanisms of Labor —In more than 95 per cent of all deliveries presentation is by the occiput The relative frequency of the types of occiput presentation are stated by Williams to be L O A 54 per cent R O A 25 per cent L O P 9 per cent R O P 12 per cent

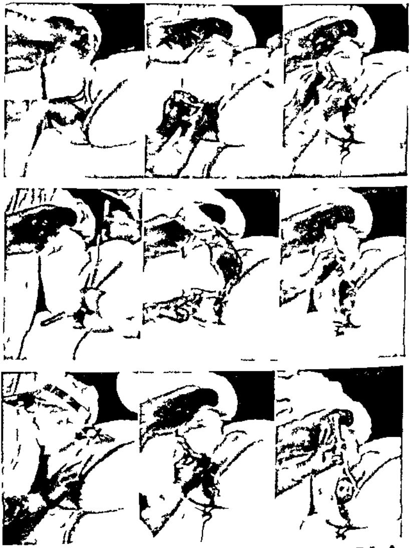


Fig 689 —Strips from motion picture of the forceps operation by DeLee *

In all probability a higher percentage of presentations begin as posterior and rotate internally to an anterior position prior to the examination of the patient

The mechanism of labor refers to the series of passive movements of the fetus as it is forced through the birth canal by the dynamic powers

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Passage is facilitated by the adaptation of the more favorable diameters of the fetal head to the variations in size and shape of the birth canal as the passenger progresses

L.O.A.—The mechanism of labor in the more frequent presentation of L.O.A. (left occiput anterior) includes the steps of descent flexion internal rotation extension and external rotation

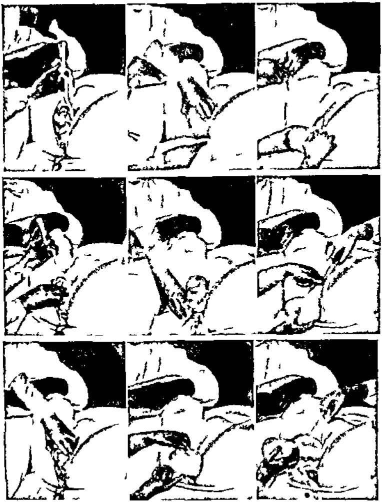


Fig 688—Continued from Fig 68 Note light traction without compression and blades removed to save the perineum

DESCENT—Engagement takes place and is followed by descent In primiparas descent may take place during the first stage of labor or even previous to the beginning of labor In multiparas descent may not begin till labor is well advanced

FLEXION—In the majority of instances the head is moderately flexed at the time of engagement and this flexion increases as the head descends

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into the pelvis Flexion is due to the more marked resistance on the fro[nt] portion of the head than on the occiput When the head reaches the pelv[ic] floor there is a marked increase in flexion

INTERNAL ROTATION —Rotation of the head through an angle of approximately 45° takes place while the head is in the mid pelvis but more fr[e-]



Fig 684 —O L A —O L 45 degrees *

quently when the head descends to the pelvic floor The resistance of the pelvic floor brings the sagittal suture to a vertical position

EXTENSION —Up to the time that the fetal head reaches the pelvic floor its movement is downward Upon meeting the resistance of the pelvic

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floor it is forced anteriorly In order to pass beneath the symphysis pubis and the ischiopubic rami marked extension of the neck must take place In this manner the occiput presents at the vulva and as extension and *downward passage continue* the head *gradually emerges over the posterior* fourchette The brow appears first and then the face and chin

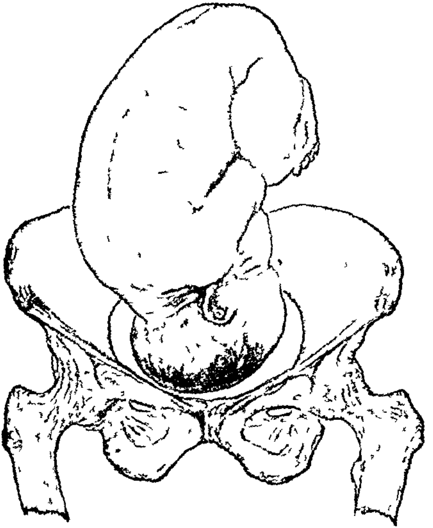


Fig 683 —O D A —O D 45 degrees

EXTERNAL ROTATION —The internal rotation of the head is not accompanied by a similar degree of rotation of the shoulders so that there is an angle of 45 between head *and shoulders Following expulsion of* the head restitution takes place the head turning 45 to the left (external rota

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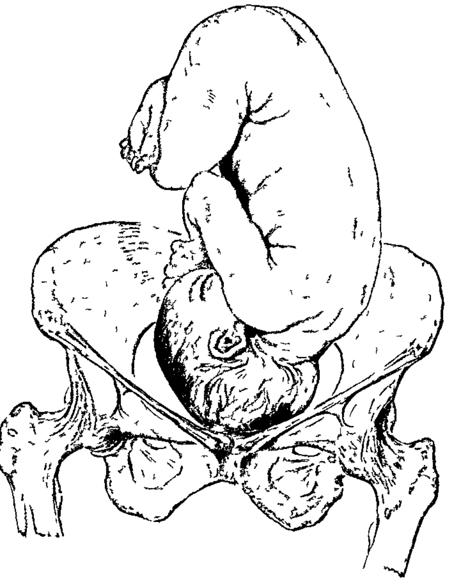


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rotation may lead to deep transverse arrest which requires operative correction

Face Presentation—In face presentations the head enters the pelvis in marked extension and descent takes place more slowly than in occiput presentation As the head progresses extension is increased until the head

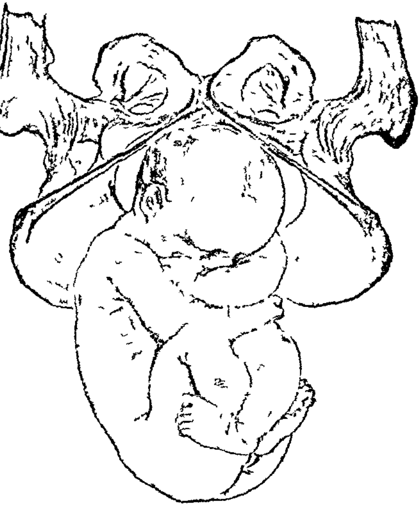


Fig 687 —O.L.P—O.L 13 degrees

becomes firmly impinged against the pelvic floor Considerable damage may occur to the baby due to marked overstretching of the structures of the anterior portion of the neck The head may emerge by flexion in the order of face brow bregma and occiput

Brow Presentation—Brow presentations are even less frequent than those of the face Unless this presentation is corrected to an occiput or face presentation delivery is extremely difficult

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tion) The shoulders then pass through the pelvis in the same plane as the head

R O A—The mechanism of labor is the same in right as in left occiput anterior presentations except that internal rotation is toward the left and external rotation is toward the right

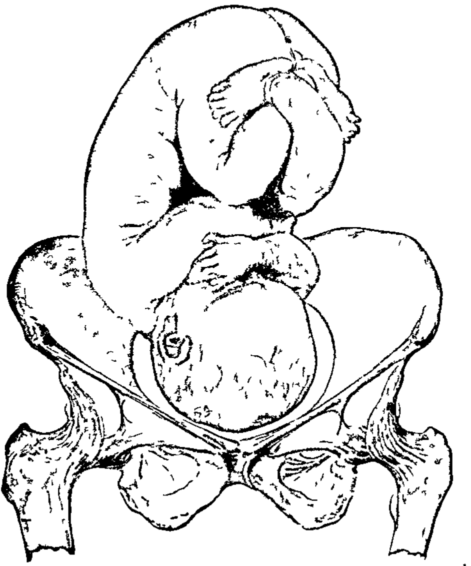


Fig 650—O D I—O D 135 degrees Radiography has shown that before the actual labor the child has much freedom of motion of its limbs and is folded tightly together thus only in a dry uterus

Occiput Posterior Positions—In the majority of occiput posterior presentations the head rotates to an anterior position by passing through an angle of 135° If this rotation fails to take place delivery is more complicated as larger diameters are presented As a result there is greater stretching and deeper lacerations are apt to occur Failure of complete

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gown mask and gloves Vaginal examination is indicated when labor is prolonged when there is uncertainty concerning position when transverse arrest is suspected and when it is essential to locate the position of sagittal suture and fontanelles Vaginal examination increases the danger of introducing infection and should be omitted whenever possible

Fetal Heart Sounds —The fetal heart is auscultated and counted during the first stage of labor whenever rectal examination is made If a bell type stethoscope is used the heart sounds are more plainly heard if the bell is

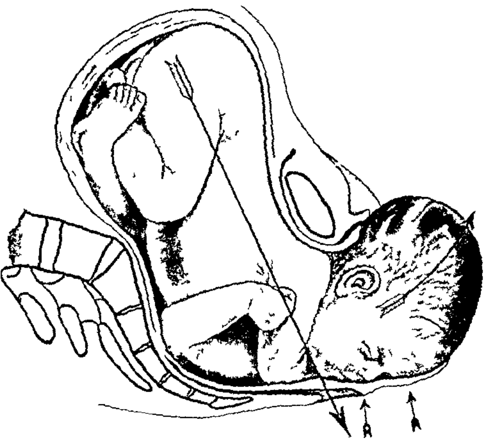


Fig 659 —Movement of extension and disengagement

held in contact with the abdomen by a rubber band The use of a special heavy obstetrical stethoscope increases the volume of the heart sounds During the second stage the heard sounds are auscultated at frequent intervals as they afford the only accurate means of detecting fetal distress If the physician is scrubbed up a head stethoscope may be used

THE CONDUCT OF NORMAL LABOR

Normal labor is subject to innumerable variations The onset may be heralded by the show a sudden gush of fluid resulting from rupture of

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Breech Presentation—Breech deliveries present a fetal mortality approximating 10 per cent Correction by external version before the beginning of labor is advocated since manipulation cannot be accomplished after labor has begun The recognition of breech presentation which cannot be corrected by external version calls for consultation with the specialist

OBSTETRICAL PROCEDURE

When the physician is summoned at the onset of labor it is advisable to reexamine heart and lungs blood pressure is noted urinalysis is made and the abdomen is palpated The frequency duration and intensity of uterine contractions are noted During an effective contraction the abdomen has board like rigidity contractions persist for 45 to 90 seconds and recur at two to three minute intervals

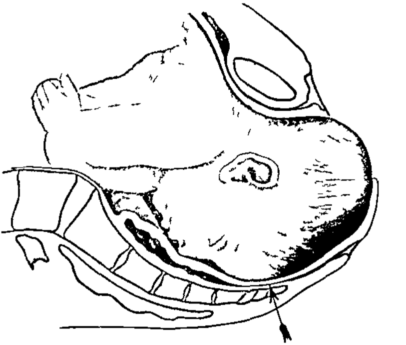


Fig 658—Increased flexion of head at perineum Arrow indicates direction of force

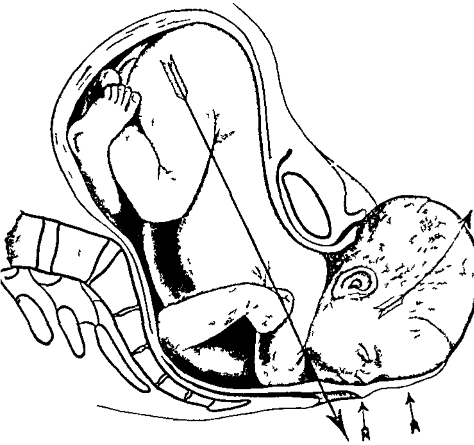
Rectal Examination—In order to judge the progress and other characteristics of labor it is essential to know the condition of the cervix Its thickness consistency and degree of dilatation are important elements in predicting the length and character of the labor This information may be acquired by rectal examination using clean or sterile glove and lubricant Rectal examinations may be made as frequently as required but since they are distasteful and uncomfortable to the patient only as many should be done as are necessary accurately to follow the progress of labor

Vaginal Examination—If it is not possible to obtain the required information by rectum a vaginal examination is indicated For this the patient is prepared in the same manner as for delivery The practitioner uses aseptic technic including thorough scrubbing and wearing sterile cap

* DeLee and Greenhill The Principles and Practice of Obstetrics 8th Ed

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the membrane or continuous low backache with recurrent cramplike pains in the lower abdomen Only rarely are the preliminary contractions not reported and the parturient does not become aware of the onset of labor until she experiences severe contractions which last 30 to 40 seconds and may occur every two or three minutes

First Stage—Labor pains usually increase progressively in frequency intensity and duration becoming most severe at the termination of the first stage *During the first stage the physician is prepared to administer* the preliminary basal analgesia using morphine or demerol with scopolamine or the usual hypnotic capsule in a dose that is three or four times what is ordinarily employed for the production of sleep

With the onset of the more severe and more frequent pains the preanesthetic medication may be repeated at intervals *according to the best* judgment of the practitioner He must attempt to withhold the drug as much and as long as possible in order to prevent asphyxiation and other disturbances relative to the fetus but he owes it to the parturient to be as generous as possible in order to allay her pains and prevent premature exhaustion

The time of rupture of the membranes is a variable but it occurs most often after the cervix has become completely dilated Premature rupture before the head is well engaged may be conducive to prolapse of the cord Failure of rupture with the consequent birth of the child within the amniotic sac is not a dangerous occurrence The folklore concerning *birth* with a caul is without physiologic confirmation

Second Stage—With dilatation and effacement of the cervix the onset of delivery is imminent At this time the conscious patient may attempt to aid the expulsive powers by voluntary contraction of the abdominal muscles an advantage that is most clearly demonstrated with *continuous* caudal anesthesia

Anesthesia—With dilatation of the cervix the practitioner is justified in inducing inhalation anesthesia (p 2679) or he may rely upon a presacral block or continuous caudal instillation

Preparation—Whatever method of anesthesia is used *the patient is* made ready for delivery by being placed in the lithotomy position her legs supported by stirrups or held by a folded sheet placed beneath the knees and supported behind the back The perineal region is shaved lower abdomen vulva anus and buttocks are painted or sprayed with antiseptic leggings are placed over the legs and the patient is draped with sterile sheets and towels The bladder is emptied by catheterization As soon as the head is on the perineal floor inhalation anesthesia is administered unless the continuous caudal method is being employed

Determination of Position—It is at this time that the position of the head *is determined by palpation of the sagittal suture and the fontanelles* In the normal delivery the occiput occupies the left anterior position Other presentations may be regarded as abnormal and require that the practitioner obstetrician consider consultation with the specialist

Episiotomy and Low Forceps Delivery—It is at this point that we recommend routine episiotomy with low forceps delivery as previously described (p 2693)

Birth of the Head—If delivery is to be spontaneous the perineum is

closely watched Overrapid distention of the vulva calls for direction of the occiput toward the lower region of the symphysis in order to increase extension The head is not held back This practice endangers the baby

As soon as the head can be grasped manually or by low forceps the normal mechanism of labor is promoted assisting first with flexion then internal rotation of the occiput to the median line then extension followed by external rotation to correct the twist that has been created between head and shoulders

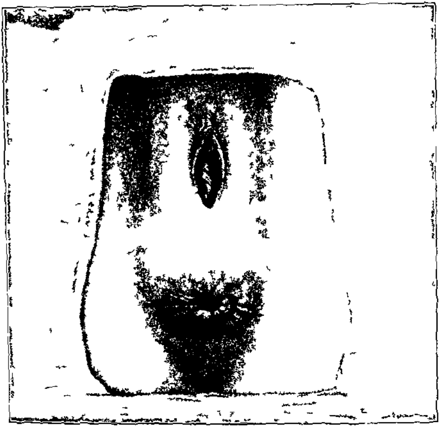


Fig 690—Birth of head scalp appearing at vulva *

Should delivery of the head cause blanching of the perineum and threatened laceration an episiotomy is done if one has not been previously performed Then following the episiotomy as before a prophylactic low forceps delivery is advisable if not mandatory

Immediately after the birth of the head a finger is passed back to the child s neck If a loop of cord is palpated it is drawn down and slipped over the head If the cord is tightly wrapped around the neck and cannot be withdrawn it should be doubly clamped and cut

Birth of Shoulders—If the shoulders are not spontaneously born they

* Stander H J Obstetrics D Appleton Century Company Inc 1945

should be extracted by grasping the sides of occiput and chin after external rotation has taken place Gentle downward traction is made until the anterior shoulder appears If any difficulty is experienced external pressure on the fundus is preferred to traction on the head Following delivery of the anterior shoulder upward traction is instituted for extraction of the posterior shoulder

The Care of the Newborn Baby —See p 2747

Repair of Episiotomy—See p 2694

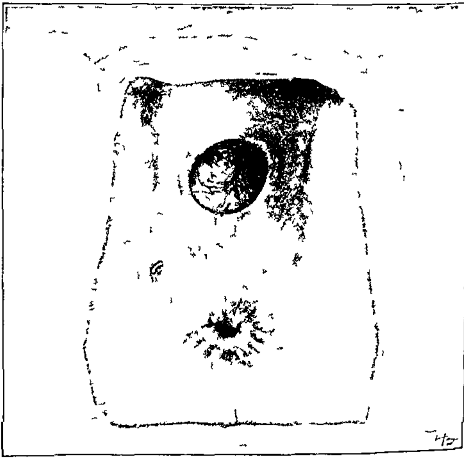


Fig 691—Birth of head vulva partially distended

The Third Stage of Labor—It is customary to wait until pulsations of the cord have ceased before clamping and ligating the cord Following this the uterus is gently massaged until the placenta has separated and can be manually expressed After expression of the placenta 1 cc of ergonovine is administered intramuscularly or intravenously

The conservative procedure is to wait for spontaneous separation and extrusion of the placenta If this does not occur within 15 to 30 minutes Crede s method of obtaining separation and expulsion is instituted by grasping the fundus massaging it in an effort to stimulate contractions

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and by downward pressure in the axis of the birth canal Following delivery of the placenta ergonovine is administered for the prevention of post partum hemorrhage (p 2717)

Our own preference for the management of the third stage of labor differs somewhat from the routine of most obstetricians Directly after the birth of the head and before the shoulders are extracted we recommend the intravenous injection of 1 cc of ergonovine 0 2 mg ($^1/_{320}$ grain) Directly the infant is born the cord is doubly clamped and ligated Then within 60 to 90 seconds after the delivery of the fetus the placenta is

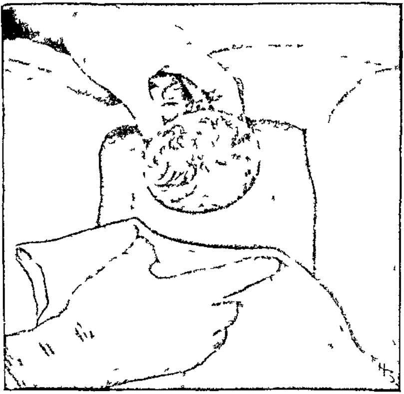


Fig 692 —Birth of head vulva completely distended *

spontaneously expelled and the uterus contracts down firmly The advantages of this technic are the shortening of the third stage of labor marked decrease in maternal blood loss prevention of neonatal anemia due to retention of blood in the placenta and avoidance of the necessity to wait for pulsation of the cord to cease before it can be clamped

CONDUCT OF LABOR WITH CAUDAL ANESTHESIA

When vaginal delivery is anticipated it is advised that continuous caudal analgesia not be started until the patient is in actual distress and labor definitely established The presenting part should be engaged and in

* Stander H J Obstetrics D Appleton Century Company Inc 1945

primiparas the cervix should be at least 3 cm dilated Best results are secured when the contractions are regular of at least thirty seconds duration and not more than five minutes apart and when not more than eight hours are expected to elapse between induction of analgesia and delivery

Caudal anesthesia may be supplemented by basal anesthesia exactly as in labor under other conditions Preliminary doses of morphine sulfate 10 to 15 mg (1/6 to 3/16 grains), dilaudid 2 mg (1/30 grain) or demerol 50 mg (3/4 grains), are permissible supplemented with scopolamine hydrobromide in an amount approximating 0 5 mg Additionally barbiturates *are employed both for sedation and to combat sensitivity to local anes*



Fig 693 —Birth of head showing delivery by extension

thetic The usual hypnotic may be given in single or *double dosage using* 90 to 180 mg (1½ to 3 grains) of seconal nembutal or amytal

Hingson and Edwards prefer to leave the patient in her own hospital room until time for delivery There she may have reading matter radio and visitors and can enjoy natural sleep because she has no discomfort It is advisable to obtain the cooperation of the patient by explaining briefly to her the purpose and mode of action of the procedure

An enema always precedes administration of the analgesia unless the progress of labor is too rapid For induction of analgesia by a right handed

* Stander H J, Obstetrics, D Appleton-Century Company Inc, 1941

operator the patient lies in her bed on her left side with her right knee drawn up sharply and her left thigh and leg slightly flexed The soles of her feet should be visible and accessible to the obstetrician Insertion of the needle may be somewhat easier with the patient in the knee chest position but the negative pressure which this position induces in the caudal end of the subarachnoid space may render puncture of the dura more difficult to detect

With both surgical and obstetric patients scrupulous aseptic precautions should be taken The surgeon should scrub and the skin of the pa

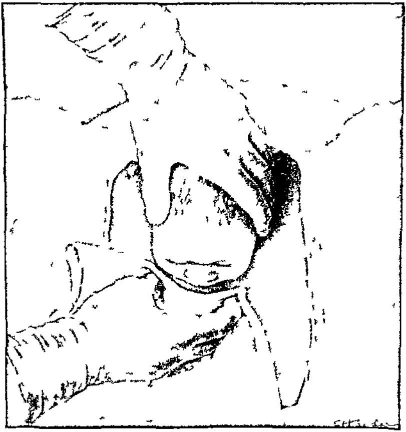


Fig 694—Birth of head, mouth appearing over perineum

tient s sacral and upper gluteal regions should be prepared surgically and draped with sterile towels

Management of Delivery—Because of the slight danger of precipitation the obstetric patient can safely be left in her bed until the presenting part can be seen by spreading the vulva Many consider that she should turn over in bed only with the assistance of a nurse and not lie on her back The supine position not only carries a hazard of displacement of the

Stander H J Obstetrics D Appleton-Century Company Inc 1945

needle but may also predispose to postpartum backache However Irving using the catheter technic allows his patients to turn over and lie on their backs at will

The mother is taken to the delivery room with the apparatus in place The perineum is prepared with Tincture of Green Soap and an antiseptic The patient is draped and the delivery is carried out according to the preference of the obstetrician Spontaneous birth is accomplished by having the patient make strong expulsive efforts during uterine contractions If manipulations or the application of forceps is anticipated a supple

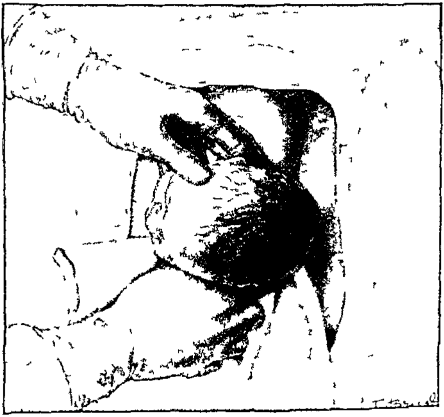


Fig 695—Birth of head external rotation

mentary injection should be given when the patient is moved to the delivery table

In the experience of Hingson and Edwards delivery of breech presentation is greatly facilitated by continuous caudal analgesia The premature baby has an improved chance since labor has been shortened and the child is spared a severe dehydration period and excessive birth trauma from resistance in the birth canal

Course of Labor Under Caudal Anesthesia.—The progress of labor under continuous caudal analgesia is somewhat different from that in which this method is not used Cervical dilatation is usually rapid in both primiparas and multiparas, and the first stage of labor is materially shortened an

* Stander H J., Obstetrics, D Appleton Century Company Inc., 1945

effect apparently due largely to cervical and perineal relaxation Likewise the early part of the second stage is facilitated

Once the fetal head is on the perineum however spontaneous progress usually stops for uterine contractions alone are seldom adequate to produce the extension of the fetal head which must precede delivery The progress of labor should therefore be checked periodically lest the second stage be allowed to continue indefinitely Once the caput is visible delivery may be effected either by the parturient herself or by the use of forceps While the patient is unaware of her uterine contractions and lacks any compulsion toward straining she is ordinarily able to use her abdominal muscles Delivery may often be accomplished if an attendant will keep a hand on the fundus and have the patient make expulsive efforts during uterine contractions Some patients cannot and others will not push in these outlet forceps must be used at least to effect extension of the head

The incidence of persistent posterior position and transverse arrest is increased under continuous caudal analgesia apparently because of the extreme relaxation of the pelvic floor This same relaxation however facilitates greatly the application of forceps and rotation of the head In transverse arrest Lull frequently applies the posterior blade and completes the anterior rotation by gentle pressure on the blade as the patient bears down with each uterine contraction

While in some ways it is a disadvantage the lack of expulsive desire at the end of the second stage is in other ways an advantage to the accoucheur since the patient is able to cooperate fully in giving him complete control of the progress of the head over the perineum

When the mother is under continuous caudal analgesia especial care is necessary to clear the respiratory passage of the infant at the first possible moment for the babies are usually ready to breathe as their noses cross the perineum This quick onset of spontaneous respiration is one of the striking features of the method With it there have been no resuscitation problems

The rapid separation and expulsion of the placenta from the uterus without the administration of oxytocics is also remarkable In fact uterine tone is so high that manipulation of the uterus should be avoided and administration of oxytocics delayed until after delivery of the placenta in order to prevent retention after separation

Hingson and Edwards report a smaller blood loss with continuous caudal analgesia than with other methods In their own series the average measure blood loss was 30 to 90 cc Often that lost from episiotomy incision exceeded in volume that from the uterus Postpartum complications are conspicuously absent

The average duration of analgesia in 679 primiparas was 6½ hours and in 371 multiparas 2 hours and 20 minutes

During the course of labor and after delivery patients may have a normal food and fluid intake since the method does not interfere usually with gastro intestinal function or normal metabolism The occasional occurrence of vomiting need not interdict the taking of food and drink

During the course of continuous caudal analgesia sensory fibers from the urinary bladder are blocked along with those from the uterus The

bladder must therefore, not be neglected The patient is, of course catheterized as usual just before delivery but if labor lasts more than a few hours the bladder should be emptied again This can often be accomplished with little difficulty by placing a sterile emesis basin against the perineum between the thighs with the patient lying on her back and pressing in on the lower abdomen just above the symphysis Gentle pressure is often sufficient to induce relaxation of the internal sphincter When this is not the case the patient must be catheterized as frequently as indicated during the course of labor

PROLONGED LABOR

In most instances prolonged labor cannot be foreseen It is necessary therefore to give all patients maximum protection to avoid exhaustion The woman is encouraged to take foods and fluids from the beginning of labor and she is urged particularly to ingest carbohydrate in the form of sweetened cocoa malted milk and fruit juices

If uterine contractions during the first stage are persistently weak and there is evidence of primary inertia over a period of six or more hours 50 mg of demerol may be given subcutaneously This in all probability will put a stop to weak and ineffectual pain and permit the patient to sleep after which more useful contractions may be anticipated

STORMY LABOR

Severe prolonged contractions are rare at the beginning of labor but they may occur during the second stage Tetanic contractions of the uterus may harm both mother and infant and it may be necessary under these conditions to administer deep anesthesia for ten to fifteen minutes in order to reduce the force and frequency of uterine movements

INDICATIONS FOR CONSULTATION

During the course of labor the practitioner may recognize danger signals which warrant the request for consultation if an experienced obstetrician is available Untoward manifestations that give rise to anxiety include vaginal bleeding in excess of the normal show the passage of meconium increasing tachycardia the presence of elevation of temperature a change in the rate or character of the fetal heart sounds increasing dyspnea cessation of uterine contractions prolapse of the cord the appearance of a fetal part or prolonged tetanic contractions of the uterus

CHAPTER 126

OBSTETRICS THE PUERPERIUM AND LACTATION

THE *puerperium* is the six to eight week period that follows the termination of labor It is characterized by return of the maternal organism to its nonpregnant state and by the onset of *lactation* Adequate postpartum care bears an important relationship to maternal health The puerperium affords the physician his greatest opportunity to practice prophylactic gynecology since it is estimated that 50 per cent of the pelvic disorders of parous women are preventable at this time

Involution of the Uterus—After delivery it is estimated that the weight of the uterus is 1000 gm and its dimensions are *19x21x8* cm *By the end* of the sixth week the comparative figures are a weight of 60 gm and measurements of 7 5x5x2 5 cm About half of the decrease occurs during the first week and by the end of the second week the process is two thirds complete The venous sinuses which were thrombosed at the time of placental separation become organized while the arteries become hyalinized and obliterated Within a week after delivery a new endometrium is almost entirely regenerated from the remnants of the basal endometrial zone The placental site remains devoid of endometrium but shrinks rapidly until it is less than 2 cm in diameter by the time that involution is completed

While shrinkage of the uterine body is taking place the almost obliterated cervix undergoes hypertrophy and hyperplasia until the normal structure is approximated

Pelvis and Genitals—The vulval vaginal and pelvic tissues do not return to their pre gravid state until a considerably longer time has elapsed than is required for involution of the uterus The introitus tends to gape the vaginal walls sag and the pelvic floor fails to regain its normal tone for many months If there are extensive *perineal lacerations* the woman is in danger of developing mechanical disturbances such as *cystocele* (p 2537) *rectocele* (p 2536) *uterine prolapse* and *displacement* (p 2537)

Lochia—Following delivery there is a bloody vaginal discharge referred

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birth of her child The mandate was in striking opposition to the habits of lower animals who resume normal activity as soon as litter and after birth have been delivered

There is an increasing present tendency towards earlier rehabilitation of the mother This is in accordance with experiences in general surgery and medicine in which prolonged recumbency and inactivity have been demonstrated to predispose to complications such as pulmonary hypostasis and infection phlebothrombosis constipation back pain and urinary retention (p 4122) The more enthusiastic proponents of rapid convalescence have successfully and safely reduced the period of bed rest in afebrile patients to less than 72 or 96 hours their results appeal to the practitioner who has observed this same curtailed puerperium in the under privileged who seem to have very *little* more postpartum difficulties than their coddled sisters under the skin

Care of the Uterus —The first consideration following delivery of the placenta is that of maintaining firm contraction of the uterus in order to prevent *postpartum hemorrhage* (p 2717) The fundus is held by a nurse or attendant and 1 cc *of ergonovine is injected for oxytocic effect*

Postpartum Hemorrhage —Excessive bleeding from the vagina following the birth of a child is a common cause of *maternal death* It has been estimated that this complication is encountered in approximately 1 per cent of pregnancies

Etiology —Postpartum hemorrhage may arise from the *placental site* or from trauma to the *maternal soft parts* Hemorrhage from the placental site may be due to a variety of causes such as *uterine inertia overdistention of the uterus* due to multiple pregnancies hydramnios or a large baby *Retained fragments of placental tissue* interfere with efficient closure of the maternal blood sinuses and tend to cause bleeding as long as they remain within the uterus Other *less common causes of severe postpartum* bleeding are *placenta praevia premature separation of the placenta* and the presence of *tumors* Injuries to the *soft parts* that cause hemorrhage include extensive lacerations of perineum vulva vagina or cervix

Technical factors which lead to bleeding include *precipitate labor* and the too early application of the Crede method of manual expression of the placenta Occasionally postpartum hemorrhage occurs for no apparent reason and recurs with each subsequent pregnancy

Clinical Manifestations —Profuse *vaginal bleeding* may occur directly after the birth of the child and before the placenta is expelled but most often the onset is within one hour after delivery of the placenta The patient exhibits the *signs of exsanguination of varying degree* depending upon the amount and rapidity of blood loss The uterus is soft enlarged and relaxed

Treatment —The prevention and treatment of postpartum hemorrhage are accomplished by a rigid adherence to the routine suggested by Beck

1 The uterus is *held* for at least one hour after the placenta is delivered gentle *massage* is instituted to prevent relaxation

2 After delivery of the placenta 1 dram of fluid extract of ergot is given by mouth and 1 cc of *pitocin ergotamine tartrate* or *ergonovine hydrocrylate* 0 2 mg (1/320 grain) is given intramuscularly every 4 hours for eight doses

to as the *lochia rubra* This tends to become less hemorrhagic and by the end of the twelfth day it is almost white The *lochia alba* persists for several weeks but is prolonged if any infection is present The normal lochia is free from offensive odor unless there is retention of membrane or superimposed infection

Abdominal Wall—The puerperal abdominal wall is lax flaccid and weakened Often there is a diastasis recti which may be permanent if corrective exercises and adequate corseting are not ordered The purplish striae lose their color decrease in size and remain finally as silvery white scarlike evidences of the pre existent pregnancy

Constitutional Manifestations—During the first twenty four hours of the puerperium there may be a slight *elevation of temperature* up to 100 4° F Should this persist for more than two or three days it may be assumed there is some infective focus which requires attention, likely sites are endometrium vulva breasts and pelvic or leg veins

The minute *pulse rate* commonly falls to 60 after delivery and the *bradycardia* may continue for several weeks Rapidity of the pulse rate suggests the presence of hemorrhage infection or cardiac failure

There is a definite postpartum *weight loss* that usually amounts to approximately 10 per cent of body weight In all likelihood this is due to inactivity restriction of diet and the metabolic readjustment that is characteristic of the period

After pains—After pains resembling labor pains are caused by uterine contractions and may persist for twenty four to forty eight hours after delivery They are often precipitated by attempts to suckle the infant Persistence of cramping suggests that the uterine cavity may not have been completely evacuated and calls for investigation

Laboratory Findings—Following delivery of the child the hemogram reveals a moderate degree of *secondary anemia* and a *leukocytosis* of 15 000 to 18 000 white cells which may persist for the first week even in the absence of infection The postpartum *urine* contains a small amount of albumin and a few white and red blood cells but these abnormalities should disappear within a few days

Breasts—The termination of gestation and placentation is associated with the onset of *lactation* During the first two or three postpartum days the breasts secrete an increasing amount of *colostrum* the mammary glands are engorged firm and tender As the true lacteal secretion initiates in another twenty four to thirty six hours swelling and pain subside and nursing can be accomplished

Psyche—Following birth of the child the mother ordinarily exhibits the curious but understandable admixture of gratification relief satisfaction and fatigue Often the sensorium remains considerably clouded by the amount of pre anesthetic medication particularly when generous doses of the *barbiturates* (p 3839) and/or *hyoscine* have been employed These alterations rapidly disappear

THE HYGIENE AND MANAGEMENT OF THE PUERPERIUM

Until recently there was general agreement that the mother required hospitalization or bed rest for at least ten days or two weeks after the

Diet—The mother is urged to resume an adequate intake of fluids and food as soon as she recovers from the effects of anesthesia For the first day or two it is wise to cater to her whim and permit her to eat pretty much as she pleases Later particularly if she is to nurse her baby a balanced diet is prescribed as elsewhere described (p 2629)

Bed Rest and Exercise—*If the parturient woman is to be kept in bed* the conventional ten days to two weeks she must be encouraged to turn from side to side at frequent intervals contract her leg muscles and move her feet so as to avoid *venous stasis* and *phlebothrombosis* Abdominal exercises are encouraged (p 3757) in order to regain the lost tonus and *favor uterine involution An abdominal binder* is applied snugly and maintained for ten days until the corset can be adjusted Those who favor an abbreviated period of bed rest permit the patient to get up for urination and defecation within thirty six hours after which she is encouraged to sit stand and walk about her room with increasing freedom after the third or fourth *postpartum day*

Lactation—The practitioner obstetrician should urge each mother to breast feed her baby The advantages include optimum diet for her infant and promotion of uterine involution The usual deterrents are psychogenic and esthetic Many women dislike the act of suckling others do not wish to be tied down to a *nursing* schedule and have been told that nursing tends to destroy the beauty of their breasts These arguments are mostly fallacious but if the mother is adamant artificial feedings (p 2751) are begun and an attempt is made to suppress lactation by the administration of stilbestrol Beginning twenty four hours postpartum 5 mg doses of diethylstilbestrol or hexestrol are given four times daily for four days until pain swelling and milk secretion have been dissipated The practice of giving purgative doses of epsom salts to dry up the breast is ill advised it dehydrates the mother and may be sufficiently irritating to produce hemorrhoids Should the breasts become engorged an ice cap is applied over a tight binder Testosterone propionate in 10 mg doses may be substituted for estrogen if the latter produces nausea Injections are given intramuscularly once daily for four days

Should the mother elect to nurse her baby a feeding schedule is arranged and she is instructed as to the care of her breasts and nipples A breast binder is applied with sterile pads to cover nipples and areolas Prior to suckling the breast is cleansed with boric acid solution and washed with sterile water After nursing the sterile pads and binder are reapplied

Disturbances of lactation may be encountered Absent or insufficient milk secretion (agalactia) may be successfully treated by injections of the lactogenic factor of anterior pituitary extract (p 2520) Hyperlactation may be managed by requesting the mother to wet nurse other infants or by withdrawal of her milk by breast pump Later if suppression of lactation is desired stilbestrol may be given as indicated elsewhere (p 2516)

Recuperation—In her postpartum period the mother is instructed to assume *the knee chest position for fifteen to twenty minutes* once or twice daily and to practice walking on all fours with straight knees (*monkey walk*) These suggestions are mandatory if the uterus is retroverted large

3 If there is evidence of retention of placental tissue within the uterine cavity *manual removal* under aseptic conditions is carried out

4 Prior to labor the woman s blood should be typed Plasma or citrated blood is to be at hand as soon as it becomes apparent that blood loss is excessive

5 In the event of active bleeding the uterus is vigorously massaged and pitocin or ergonovine is given intramuscularly With the continuation of bleeding vulva clitoris vaginal wall and cervix are examined for lacerations and bleeding points are caught if they are visible If this fails to control bleeding the uterus must be packed and a transfusion is given

6 *Concealed bleeding* is recognized by elevation of the pulse rate which is to be counted hourly for the first day or two days following the birth of the child If manifestations of exsanguination are not controlled by transfusion the patient must be examined under anesthesia to discover and repair the causative disturbance

Care of the Vulva —The vulva is regarded as an open wound and care is taken to prevent infection The lochia is allowed to drain on to a sterile absorbent pad that is placed beneath the buttocks for the first forty eight hours Subsequently sterile vulval pads are used and are changed as often as is necessary which usually averages four to five times daily With each change of pad and following defecation or urination the vulva is cleansed with 0 5 per cent lysol or 1 2000 bichloride of mercury Douches are avoided and the patient is warned to keep her hands away from the genital region

Repair of Tears and Lacerations —The modern obstetrician prevents the majority of perineal lesions by prophylactic episiotomy Tears and lacerations that have resulted from the ordeal of parturition are immediately repaired in order to prevent infection and the later appearance of mechanical disturbances

Care of Bladder and Rectum —The patient must not be permitted to go without micturition for more than eight hours Attempts are made to re establish voluntary urination this failing intramuscular injection of 1 or 2 cc doryl (p 3874) often is effective If *catheterization* becomes necessary the greatest care is taken to avoid contamination Under no circumstances is the bladder permitted to become distended Routine perineal care consisting of a flush with sterile water is required after each voiding or defecation

Evacuation of the bowels is usually hindered by prolapse or thrombosis of *hemorrhoids* which frequently complicate labor If it is at all possible the prolapsed mucous membrane is replaced within the anal canal and held in situ by the insertion of a gauze plug lubricated with vaseline A spray of epinephrine chloride 1 1000 often causes shrinkage of the pile and permits replacement Wet dressings of saline solution milk or witch hazel are often grateful and a local anesthetic such as 2 per cent nupercainol may be applied

Whether or not the problem of defecation is complicated by hemorrhoids a gentle *soapsuds enema* is advisable on the third or fourth day If there is considerable pain rectal instillation of oil is most gratifying After the night of the third postpartum day Liquid Petrolatum 60 cc (2 ounces) should be given orally before retiring

Infections
- **Puerperal Sepsis** (p 2606)
- **Puerperal Endometritis** (p 2602)
- **Pelvic Thrombophlebitis** (p 2604)
- **Phlegmasia Alba Dolens** (p 2648)
- **Breast Abscess** (p 2546)

Mechanical Disturbances
- **Uterine Displacement** (p 2537)
- **Cystocele** (p 2537)
- **Rectocele** (p 2536)
- **Uterine Prolapse** (p 2542)
- **Perineal Tears** (p 2718)
- **Perineal Fistulas** (p 2544)
- **Cervical Tears and Erosions** (pp 2534 2544)

Vascular Disturbances
- **Varicosities of the Vulva** (p 2535)
- **Varicosities of the Legs** (p 969)
- **Hemorrhoids** (p 2718)

Miscellaneous
- **Lumbosacral Strain** (p 3063)
- **Sciatica** (p 3072)
- **Postpartum Psychoses** (p 2720)

and soft and may be begun on the fifth postpartum day They are continued for at least two weeks

The patient is warned that *menstrual periods* may not appear for several months Since sexual intercourse is ordinarily resumed at the end of four to six weeks impregnation may occur It is worth while to call to the patient s attention the fallacy of the 'old wives' tale that lactation prevents impregnation The woman who has had a difficult labor is advised to practice contraception for some period unless she has scruples to the contrary

Each month after delivery for two or three months a careful physical examination is performed If the uterus fails to resume its position of anteflexion it should be maintained in the normal position by the use of a *pessary* (p 2538) *Cervical lacerations* and *erosions* that fail to heal with simple douches are cauterized (p 2601) *Venous varicosities* in the legs require injections (p 3941), and painful or prolapsed *hemorrhoids* (p 1916) may require sclerosing or operative therapy

The woman is encouraged to build up the tonus of her abdominal wall and maintain the tenseness of her breasts There is no excuse for sloppiness The modern woman who bears a child need not sacrifice her appearance or her figure

Postpartum Depression—Mild postpartum depression lasting forty eight to seventy two hours is extremely common The usual onset of this period is concomitant with the early phase of lactation but may not appear for several weeks The majority of patients are unable to attribute the depression to any external factor and are more distressed by the unexplained weeping than by the depression itself For this reason reassurance by the physician that this is a common occurrence is helpful in minimizing and shortening this transitory phase This type of mild depression is more common in primiparas than multiparas The duration and depth of the depression are influenced by the individual psychologic and emotional background

Postpartum Psychoses—Postpartum psychoses are relatively common accounting for 10 to 18 per cent of the female admissions to psychiatric hospitals The derangement is not a distinct clinical entity and investigation usually indicates an underlying emotional instability or a history of a previous psychotic manifestation For this reason pregnancy and labor may be regarded as precipitating factors rather than prime causes The prognosis is usually good the majority of cases regressing to their prepregnant state within six weeks to six months

The practitioner must be on the alert to recognize early signs of depression since this type of psychosis may be associated with suicidal homicidal or infanticidal tendencies In all questionable or borderline cases psychiatric consultation is indicated

COMPLICATIONS OF THE PUERPERIUM

The principal complications of the puerperium are caused by infection mechanical disturbances and vascular injuries More complete discussions of these phenomena appear elsewhere as follows

SECTION XVIII

PEDIATRICS

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SECTION XVIII

PEDIATRICS

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NATALIE YAROW M D

CHAPTER 127

METHODS OF DIAGNOSIS AND TREATMENT

In most communities the practitioner obstetrician functions also as a pediatrician Even in large cities many obstetricians contract to care for *the newborn during the first few months of life* Hence it has seemed desirable to present a concise summary of the problems of the neonatal period infancy and childhood despite full recognition of the need for greater detail and elaboration

Neonatal Period—The importance of the neonatal period which arbitrarily spans the first month of life is emphasized by statistics of infant mortality In the United States for each thousand live births there are 40 4 infant deaths and half of these occur in the first month The greatest opportunity for infant salvage therefore is presented in the neonatal period during which the greatest hazards are congenital anomalies prematurity asphyxia birth injuries digestive and feeding disturbances and infections

The congenital abnormalities are discussed separately in the sections devoted to disturbances of the several end organ systems since many anomalies do not reveal themselves until later life and remain as threats throughout the span of existence With a few exceptions the remaining jeopardies of the neonatal period are treated in the chapters of the present section

Infancy and Childhood—The clinical disturbances of later infancy and childhood are tabulated in the present section (p 2758) and references are made to complete discussions elsewhere in the text While it is recognized that the young human organism responds somewhat differently than the adult the principal variant is quantitative rather than qualitative Considerations of economy preclude repetitions of descriptions of disease and programs of therapy as they apply to the child in contrast to the adult

The practitioner unaccustomed to pediatric problems may be guided by these general principles in handling infants and children

1 The child is an adult in miniature and possesses the same tissues organs sensibilities and reactive mechanisms

2 The child is more susceptible to digestive disturbances and certain infections notably those caused by coccal invaders tubercle and influenza *bacilli* and the viruses of poliomyelitis and the exanthems

3 In all disease occurring during the period of anabolism permanent damage may result from interference with the normal developmental processes and with the factors of growth

4 The treatment schedule for the child employs the same modalities utilized in adult life but lesser *dosages must be employed In general* the amounts required are greater weight for weight but rules of thumb and percentile ratios may not prevail The infant needs relatively more sulfonamide penicillin salicylate or opiate and few physicians would pre

sume to dictate the exact quantums in any given case except by the method of trial and error The 'compleat practitioner having set his course administers an initial probatory dose and after observation of its effects increases or decreases subsequent amounts according to the reaction and the need

5 The child being unaware of the implications of illness enjoys both advantages and disadvantages in the struggle for survival If on the one hand anxiety does not add its burden to the disease the other side of the ledger is weighted by inability of the patient to report subjective symptoms or cooperate in therapy

HISTORY

The history of the newborn child or infant records relatively few facts but these are of signal importance The parent is asked for the following information

1 The general health of mother and father Serum tests for syphilis and Rh factors should be performed when indicated
2 Previous pregnancies abortions or stillbirths
3 The presence and severity of complications of pregnancy
4 The nature of the delivery whether instrumental or spontaneou precipitate or prolonged and the nature of the obstetric anes thesia
5 Notation of birth weight and height
6 The onset intensity and duration of jaundice (p 2761)
7 The nature of the sucking reflex or disturbances related to it
8 The number and character of the daily stools
9 The presence and degree of asphyxia (p 2766) following delivery
10 The amount of motor activity and crying

With answers to these questions the practitioner gives consideration to the possible presence of prenatal syphilis and to the sequels of prolonged delivery dystocia instrumentation excessive anesthesia or as phyxia neonatorum He regards with particular concern the child that is premature (p 2763) underweight undersized unusually pale deeply or intensely jaundiced excessively restless suspiciously quiet and one that cries too little or too much

PHYSICAL EXAMINATIONS

The physical examination of the newborn stresses statistical data since subjective symptoms cannot be elicited and physical examination often presents difficulties Special examinations particularly myringoscopy and ophthalmoscopy must be included in the routine since aural and visual abnormalities are frequently encountered in early life

STATISTICAL DATA

The statistical information that is required includes notations of weight length and chest and head circumferences rectal temperature and res piratory and pulse rates

NORMAL MENTAL AND EMOTIONAL GROWTH AND DEVELOPMENT

At Birth and First Year—*At birth* the child is capable of moving its hands and feet he is frightened by sudden loud noises he detects the odor of milk makes his way to the source and suckles the maternal breast or the rubber nipple He resists restraint and withdraws the part that is exposed to painful stimulus

By the end of a month the child blinks when startled He follows familiar objects with his eyes and in another month apparently recognizes familiar objects such as the bottle and familiar faces particularly of his mother *At four months* he reaches for the familiar object and apparently recognizes voices *By the seventh month* he sits erect with slight support, vocalizes syllables and makes crowing sounds *By the tenth month* the

TABLE 146—STATISTICAL DATA IN THE NEONATAL PERIOD AND INFANCY

Observation	At Birth	First Year
Weight	7 to 7½ lbs (3200 to 3400 gm)	Loss of 8 oz (225 gm) in first 4 days return to birth rate on 10th day doubled at five months and trebled at 1 year
Length	0 inches (0 cm)	Gain 3.5 inches (9 cm) at 3 months 32 inches (8 cm) between 3 and 6 months and at end of first year approximates 8 inches (~0 cm)
Head circumference	13 to 13¾ inches (33 to 35 cm)	Approximates 18 inches (4 cm) at one year
Chest circumference	13 inches (33 cm)	At 6 months approximates 16 inches (40 cm) at 1 year approaches 18 inches (45 cm)
Rectal temperature	100 5 F (38 C) at birth	99 F to 100 F after first day
Respiratory rate	3 to 40 per minute Often irregular	30 to 40 at the end of the first year
Pulse rate	1 0 to 150 per minute	110 to 115 at one year

child sits alone and says mama or dada and perhaps learns a simple nursery trick such as shaking bye bye *At the end of a year* the child walks with some assistance and is able to say one or two words He begins to have an idea of obedience and should have learned sphincteric control of bladder and rectum

Pre school Age—*At a year and a half* the child is able to climb stairs and has a repertoire of five or six words bladder and rectal control are complete and the hours of sleep have been reduced from 20 per day at six months to perhaps 13 the cup is used for drinking purposes and a spoon for the ingestion of soft foods

By the *second birthday* the child can run and is able to combine words into phrases his coordination is sufficient to permit him to throw a ball and make an effort to catch

At *three years* of age the child has advanced to the stage where he assists in dressing and may even put on his own shoes He recognizes the obvious portions of his anatomy such as the eyes nose and mouth and points them out in the mirror or in pictures He begins to repeat sentences and numerals and recognizes and enunciates his own name

At the age of *four* the child knows his sex recognizes common objects and may be sent on errands in and around the house At *five* he is able simultaneously to carry out several commissions draws and copies in the familiar picture books and is able to dress and undress without assistance

At *six* the child knows the time of the day recognizes pictures that are attractive and distinguishes those that are ugly appreciates the difference between the right and left hands and is able to count through the teens He describes pictures of familiar objects names the colors and the days of the week and begins to recognize the rights of other members of the household

School Age to Adolescence—From school age until adolescence the development and mental progress of the child are best estimated by the *scholastic standing* The school record reflects the child s intellectual capacity and behavior and his ability to cooperate and play with contemporaries of both sexes

Girls develop *secondary sex characteristics* at the age of from seven to ten and the menarche occurs on or about the age of thirteen Boys lag somewhat behind in maturation and their masculine hairiness and manly voice do not become apparent until the twelfth to sixteenth years

Without the aid of complicated and intricate tests (*q v*) the practitioner recognizes which of his children are developing normally in school in extrascholastic activities and in the business of adaptation to the science of living He has no difficulty in noting the backward the maladjusted misfits and unhappy youngsters Without much formality he usually has a clear picture of the etiology of the disturbance whether organic characterologic or situational—in the latter instance most likely due to parental ignorance or misfortune See *Mental Deficiency (Feeble mindedness)* (p 1332)

CONDUCT OF THE PHYSICAL EXAMINATION

The physical examination of the newborn is conducted with emphasis on the detection of congenital abnormalities (p 2758) and traumatic consequences of passage through the birth canal (p 2771) Unless a systematic survey is instituted there is grave danger of overlooking some anomaly which may be amenable to simple therapy at this stage In the formative phase of life carelessness or neglect may result in serious consequences to the child and justifiable criticism of the practitioner obstetrician pediatrist

PHYSICAL EXAMINATION IN THE NEONATAL PERIOD AND INFANCY

General appearance

Look for evidences of dehydration inanition edema or cyanosis Note motor activity and the strength and duration of the cry Observe sucking reflex

Fontanelles

Posterior admits tip of finger at birth and closes at end of six to eight weeks Anterior approximates a diameter of 1 inch (2 2 cm) at birth and remains open until the twelfth to eighteenth month

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Fontanelles

Early or late closure of the fontanelles is easily detected by palpation Bulging and depression are dependent upon intracranial pressure relationships which may be due to local secretory or obstructive disturbances or to changes in systemic tissue hydration

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Early Closure	
Microcephalus	Round, small head usually associated with idiocy
Oxycephalus	Conical head May be associated with optic atrophy anosmia and mental retardation
Scaphocephalus	Narrow elongated head May be associated with optic atrophy anosmia and mental retardation
Late Closure	
Achondroplasia	Dwarfism with a normal or enlarged cranium
Cretinism	Congenital thyroid deficiency with dwarfism pot belly coarse features and low B M R Therapeutic response to thyroid extract (p 1189)
Internal Hydrocephalus	With macrocephalus bulging of fontanelles *and increase of ventricular fluid* (p 1409) Consult neurosurgeon
Mongolism	With obliquity of eyes and mental deficiency (p 1165)
Neonatal Syphilis	Positive serology (p 2787) Therapeutic response to specific treatment (p 337)
Prematurity	Usually due to accompanying metabolic disorders (p 2763)
Rickets	Vitamin D deficiency with deformities of bone due to epiphyseal disturbances Therapeutic response to specific treatment (p 2850)
Bulging	
Internal Hydrocephalus	With enlargement of skull and atrophy of brain tissue Best demonstrable by x ray and diagnostic ventricular tap
Meningitis	Usually meningococcal influenzal or tuberculous *as determined by cerebrospinal fluid* findings (p 1432)
Cerebral or Subarachnoid Hemorrhage	Usually traumatic with bloody or xanthochromic cerebrospinal fluid (p 2773)
Depression	
Dehydration	Due to vomiting diarrhea inanition marasmus prolonged edema or fever

DIFFERENTIAL DIAGNOSIS OF

Generalized Abdominal Pain in Infancy and Childhood

A complete discussion of the differential diagnosis of generalized abdominal pain is elsewhere presented (p 1748) The present Table deals with the more common causes of pain as encountered in infancy and childhood

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Dietary Indiscretion	Overfeeding Indigestible food. Failure to release air bubble
Constipation	Distention from high carbohydrate formula Inspissated stool in rectum. Insert suppository or give cleansing enema Supplement feedings with liquid petrolatum or milk of magnesia
Organic Obstruction	
Congenital Pyloric Stenosis	Vomiting beginning in second or third week of life Note peristalsis in epigastrium, epigastric tumor and retention of barium in contrast x ray (p 1797) If dietary treatment fails prepare for surgical intervention (p 1798)
Intussusception	Intestinal obstruction palpable tumor and presence of bright red blood in stool. If manual reduction is unsuccessful prepare for laparotomy (p 1876)
Volvulus	Complete intestinal obstruction, palpable tumor and x ray evidence of ileus (p 1875) Prepare for laparotomy
Intestinal Obstruction	From bands and other causes Same manifestations as in volvulus. If accessible hernia is not reducible prepare for surgical intervention (p 1873)
Spasmosis	Colic with normal temperature Obtain relief by releasing air bubble applying heat to abdomen, inserting rectal catheter or relieving constipation
Pharmacodynamic and Toxicologic	From administration of cathartic drugs From accidental ingestion of irritants
Local Inflammation or Infection	
Gastritis	With vomiting
Enterocolitis	With diarrhea
Acute Appendicitis	Fever leukocytosis and localized tenderness and rigidity Prepare for laparotomy (p 1881)
Mesenteric Lymphadenitis	Same signs as in appendicitis Prepare for laparotomy (p 1887)
Inflammation of Meckel s Diverticulum	Same signs as in appendicitis. Prepare for laparotomy (p 1864)
Peritonitis	Of streptococcal gonococcal pneumococcal or tuberculous origin. Get smears and cultures of fluid obtained by abdominal puncture (p 1923) Start anti infective treatment (p. 106) and consider laparotomy

CONTINUED

Systemic Infections	
Typhoid and Paratyphoid Fevers	Prolonged pyrexia and splenomegaly Get blood cultures and serum agglutination reactions (p 225)
Rheumatic Fever	Carditis and arthropathies Note therapeutic response to salicylate (p 186)
Pleuropulmonary Infection	Particularly in lower lobe pneumonia and pleurisy (p 2171) Supplement physical examination of chest with x rays
Urinary Infection	Acute pyelonephritis (pyelitis) with pyuria (p 2353) Congenital anomalies causing hydronephrosis or pyonephrosis (p 2284) Get intravenous urogram (p 2251) and consult urologist
Allergy	*Particularly the result of digestants Note* other evidences such as atopic dermatitis (p 3342) urticaria (p 3345) and angioneurotic edema (p 3349)
Hemorrhagic	Scurvy with therapeutic response to cevitamic acid (p 2857) Acute capillary toxicosis (Henoch) with cutaneous purpura (p 3423)

Cranium

Note size irregularity craniotabes separation of sutures dilatation of veins evidences of trauma and protrusions (p 2774)

Facies

Observe expression at rest and during activity (p *3509*)

Eyes

Look for icterus (p 2761) conjunctival discharge (ophthalmia neonatorum) and conjugate movements

Nose

Test for patency of nostrils Suspect syphilis in presence of snuffles

Mouth and throat

Look for deformities and rhagades of lip Observe palate Examine for exudate of pharynx and tonsils Listen to breathing for evidences of obstruction or spasm (laryngismus stridulus)

Ears

In presence of fever or discharge proceed with otoscopy (p 3609)

Neck

Look for tumors deformities cysts and fistulas (p 3509) Test for rigidity and retraction indicating meningitis

Chest

On third or fourth day breasts may be swollen with discharge of colostrum Inspect palpate percuss and auscultate chest for signs of congenital pulmonary defects or infection cardiac anomalies pericardial effusion and persistence of thymus (p 1236)

DIFFERENTIAL DIAGNOSIS OF

Stridor in Infancy

Noisy respiration in the infant is always a cause for alarm. With persistence of the stridor and manifestations of respiratory distress the practitioner must insist upon consultation with the specialist for direct laryngoscopy and bronchoscopy

See also Stridor in the Adult (p 2166)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Congenital Anomalies	Stenosis or webs involving larynx, or bronchi May be relieved endoscopically (p 2042) Redundant epiglottis
Foreign Bodies	May cause partial or complete obstruction to airway Best removed through bronchoscope (p 2046)
Congenital Laryngeal Stridor	Noisy respirations more marked on effort and diminishing during sleep Slight respiratory distress Examination normal Disturbance tends to disappear in later years
Spasmodic Croup	Acute attacks of nocturnal inspiratory croup with respiratory distress Usually occur at the ages of 2 to 4 with only slight febrile reaction Examination normal Subsidence within a few days
Laryngismus Stridulus	At approximately 18 months of age with manifestations of rickets or tetany Periods of apnea and respiratory distress followed by high pitched inspiratory crow Note therapeutic response to vitamin D and calcium (p 2166)
Nasal Obstruction	Rhinitis hypertrophied tonsils or adenoids. Findings demonstrable by anterior and posterior rhinoscopy (p 2021) Consider adenoidectomy and tonsillectomy
Pertussis	Paroxysmal cough followed by inspiratory whoop Note lymphocytosis (p 278) Consider immunization serum therapy and x ray treatment (p 3796)
Peritonsillar and Retropharyngeal Abscess	Acute onset in association with local suppuration Prepare for incision and drainage (p 2155)
Acute Catarrhal and Membranous Laryngotracheitis	With mild to moderate fever and moderate to alarming respiratory distress Summon consultant laryngologist Prepare for emergency intubation or tracheotomy (p 2164)
Laryngeal Diphtheria	Identify C diphtheriae in spreads and cultures of membrane (p 302) Administer antitoxin together with penicillin (p 106) Prepare for intubation or tracheotomy if necessary (p 3958)
Streptococcic Sore Throat	Epidemics of milk borne infection causing follicular tonsillitis Identify organism by smear and culture (p 185) Give intensive treatment with penicillin and/or sulfonamide (p 106)

CONTINUED

Neonatal Syphilis	With snuffles and stenosis of trachea. Identify pathogen by darkfield microscopy (p 47). Intensive therapy with penicillin (p 2787)
Mycotic Pharyngitis	With demonstrable pathogens in smears of exudate (p 50). Make local applications with gentian violet.
Angioneurotic Edema of Uvula or Glottis	In association with allergy resulting from digestant or medication (p 3339). Try sprays and injections of epinephrine (p 3877). Prepare for scarification if airway is occluded.
Persistence of Thymus	Causing compression and respiratory distress. Get x rays of chest and institute immediate roentgen therapy (p 1230)

Abdomen

Note stump of umbilical cord and test for herniation during cry. Palpate liver, spleen and retroperitoneal regions for evidences of enlargements or tumors. Look for visible peristalsis in the epigastrium (hypertrophic pyloric stenosis)

Female genitalia

May observe menstruation in the newborn. Inspect clitoris and vagina for congenital anomalies and evidences of gonorrheal vulvovaginitis (p 2580)

Male genitalia

Look for congenital anomalies of urethral orifice, testes and penis (p 2421)

Anus and rectum

Determine whether anus is perforate and look for evidences of prolapse or fissure of rectum. Note perineum and anal orifice for eruptions, particularly those of neonatal syphilis (p 2787)

Back

Look for swellings, tumors, hair tufts and dimples indicating spina bifida occulta. Observe curvatures of spine (p 3060)

Extremities

Note muscle activity and reflexes. Look for evidences of congenital fracture, birth palsies, congenital myopathies, carpopedal spasm, abnormal movements and increased muscle irritability

Tegumentary system

Examine skin for texture, edema, icterus, pyodermis, ecchymoses, hematomas, purpuras, cyanosis and congenital eruptions (p 3099)

Lymph nodes

Note generalized or localized lymphadenopathy suggesting neonatal syphilis, leukemia or reticulo endothelioses (p 1156)

DIFFERENTIAL DIAGNOSIS OF

Special Causes of Vomiting in Infancy

It is not unusual for the infant to vomit on occasions Almost any disturbance whether functional or organic may result in emesis When vomiting is persistent or protracted, however the practitioner institutes an intensive investigation and summons the pediatric consultant if the situation is not clarified by his own endeavors.

See also Dyspepsia in the Adult (p 1770)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Dietary	Formula too rich Feedings too frequent Failure to assist infant in releasing air bubbl
Esophageal	Congenital strictures and stenoses (p 1730) Immediate return of food Refer patient to specialist for esophagoscopy
Gastric	Congenital pyloric stenosis manifest by vomiting after the first two or three weeks of life (p 1797) Note peristalsis in epigastrium and palpate tumor at pylorus Confirm findings with small barium meal Consider surgical interference if weight loss cannot be prevented by dietary means
Intestinal	In association with diarrheal disorders particularly enterocolitis (p 2782) With intestinal obstruction due to meconium ileus in the newborn and intussusception in later life (p 1876) Confirm presence of obstruction by x ray Prepare for laparotomy unless reduction is possible Acute appendicitis with leukocytosis and local rigidity (p 1881)
Peritoneal	With all types of peritoneal irritation May result from omphalitis and gonorrheal tuberculous streptococcal or pneumococcal peritonitis (p 1923) Obtain fluid by abdominal puncture if possible (p 1823) Start anti infective therapy (p 10b) and consider laparotomy
Cyclic Vomiting	Brief attacks of persistent vomiting associated with acidosis in children between the ages of 2 and 10 If severe or persistent prepare for parenteral administration of fluids saline and dextrose (p 3775)
Infectious	In pertussis following paroxysmal cough (p 278) Consider active immunization serum therapy and roentgen treatment (p 379b) Acute capillary toxicosis (Henoch) with cutaneous purpura (p 3424) Onset of scarlet fever (p 171)
Toxic	Ingestion of irritants Drug effect with salicylate digitalis or sulfonamide With acidosis and acetonuria

Neurogenic	In association with increased intracranial tension usually as the result of birth injuries or congenital malformations Obtain cerebrospinal fluid (p 3734) and consult with neurosurgeon.
Psychogenic	Habit tantrums in sensitive high strung children

SPECIAL EXAMINATIONS

*Special examinations are often required in the investigation of abnor*malities encountered in the newborn and in infancy Certain of the procedures must constitute part of the practitioner s routine These include *myringoscopy otoscopy ophthalmoscopy digital and visual examination* of the rectum and lumbar puncture The more technical surveys are specialist province but they are mandatory in the elucidation of difficult or obstinate clinical disturbances



F 696—Showing the gastric peristaltic waves of pyloric stenosis in an infant of three weeks of age

SPECIAL EXAMINATIONS IN THE NEONATAL PERIOD AND INFANCY AND CONDITIONS IN WHICH THEY ARE OF DIAGNOSTIC VALUE

Digital examination of rectum
Congenital anomalies of rectum and anus prolapse of rectum intussusception and volvulus

Myringoscopy and otoscopy
Bullous myringitis otitis mastoiditis

Ophthalmoscopy (p 3628)
Retinitis pigmentosa retinal tubercles cherry red spot optic atrophy and papilledema
Routine procedure for examination of retina, retinal vessels and optic disk

Laryngoscopy and bronchoscopy (p 2025)
Congenital malformations of larynx and bronchi foreign bodies in upper respiratory passages acute laryngotracheitis laryngeal diphtheria.

Radiography of chest
Congenital anomalies of lungs and heart persistent thymus lobar pneumonia acute and lipoid pneumonitis atelectasis empyema thorax

Urethroscopy and cystoscopy (p 2247)
Congenital anomalies of the urinary passages producing pyuria or frequency of urination hematuria enuresis

Courtesy of Dr Carl Wagner Cincinnati Mitchell Nelson Textbook of Pediatrics, 4th Ed

DIFFERENTIAL DIAGNOSIS OF

Disturbances of Gait in Childhood

Delay in walking or disturbances of gait in infancy and childhood have profound significance since they often appear as manifestations of grave neuromuscular skeletal and metabolic disturbances

See also Disturbances of Gait in the Adult (p 3496)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Delay in Walking

Malnutrition	From insufficient or deficient diet Following prolonged illness
Cretinism	Often associated with dwarfism, coarsening of features protrusion of tongue pot belly and low B M R. (p 3739) Therapeutic response to thyroid extract
Rickets	Vitamin D deficiency with disturbances of epiphyseal development Often associated with knock knees bow legs rickety rosary and Harrison's grooves (p 2850)
Scurvy	Vitamin C deficiency with bleeding due to capillary fragility May be manifest by periosteal disturbances Therapeutic test with cevitamic acid (p 529)
Mental Deficiency	Amaurotic family idiocy (p 1412) with blindness and cherry red spots by ophthalmoscopy (p 3628)

Limp

Congenital Dislocation of Hip	With shortening of leg and abnormal arc of motion X ray evidences of posterior dislocation of head of femur (p 2828) Consult orthopedist
Coxa Vara	With shortening of limb and limitation of abduction X ray reveals abnormal angulation of neck of femur (p 2825) Consult orthopedist
Talipes	Club foot (p 2831) Consult orthopedist
Calve Legg Perthes Disease	Epiphyseal disturbance of hip usually observed in boys of Fröhlich habitus Consult orthopedist
Osgood Schlatter Disease	Epiphyseal disturbance of tuberosities of the tibia Consult orthopedist
Freiberg Kohler's Disease	Epiphyseal disturbance of metatarsals or scaphoids Consult orthopedist
Rickets	Vitamin D deficiency as above
Scurvy	Vitamin C deficiency as above
Infectious Arthritis	Particularly tuberculosis (p 2942) or rheumatic fever (p 185) of hips and knees Get x rays Note tuberculin reaction and therapeutic response to salicylate
Osteomyelitis	Bone infection usually hematogenous (p 2930) Start anti infective treatment (p 88) Get x rays Consult surgeon
Poliomyelitis	Muscle atrophy and flail leg Consult orthopedist

CONTINUED

Weak Foot	Disturbances in oot mechanics and bad shoeing Consult orthopedist
Trauma	History of injury Get x ray for fracture or dislocation
Spasticity	
Little s Disease	Congenital spastic paralysis with hyper reflexia (p 2948)
Friedreich s Ataxia	Congenital neuropathy with ataxia di turb-ances of speech and mental deterioration (p 1415)
Amyotrophic Lateral Sclerosis	Idiopathic neuropathy with muscle atrophy and fatal termination (p 2886)
Waddle	
Congenital Dislocation of Hip	See Limp
Coxa Vara	See Limp
Muscle Dystrophies	With evidences of hypertrophy or atrophy of skeletal muscle (p 2880) Associated with asthenia
Totally Irregular Gait	
Chorea	With normal motor and sensory findings but other evidences of the syndrome of rheumatic fever (p 190)
Cerebellar Ataxia	Congenital malformation Consult neurologist

I a ve of stomach tube
C n tal anomalies of esophagus

Bar um meal
For contrast roentgenography in conge ital anomalies of esoph gus and toma h

Barium enema
For contr st roentgenography n congenital m lformations of lo r bowel intussu ep tion and olvulus

Radiographs of bone
For study of bony development at epiphyses for evidences of fracture for congenital anomalies of skeletal structures for ep physeal disturbances in rickets cret n sm scurvy and in neonatal syphilis

Radiographs of spine
To reveal congenital anomal es particularly sp na bifida oc ulta

Radiographs of skull
Disturbances of cranium or head birth t auma congenital anomal es cerebral calcif a tion in tube ous scleros s and toxoplasmosis

Electro-encephalography (p 1403)
In neurological disorders congenital anomal es cerebral dy functio na colep y and convulsions

Pneumo-encephalography (p 1410)
In the investigat on of hydrocephalus po enc phaly and ce bral cysts

Psy hometry (p 1325)
To dete mine mental de elopment or status in mental deficiency moronity and id ocy and n cretinism

Lumbar punctu e (p 3781)
Birth trauma enc pl alitis pol omyeliti m ng ti neo at l syph lis

Ventricular puncture (p 3 83)
Particularly in hyd ocephalus

Subdural tap

When there are evidences of intracranial bleeding in birth and other traumas and in congenital aneurysms

Audiometry (p 2017)

For investigation of hearing and in amaurotic family idiocy and neonatal syphilis

Skin tests (p 60)

Schick Dick Schultz Charlton tuberculin serum sensitivity and in allergies

Electrocardiography and cardiac roentgenology (p 803)

In investigation of congenital cardiac disease

TABLE 146-A—ANEMIAS OF INFANCY AND CHILDHOOD

Variety	Pathognomonic Findings
Physiological (p 1086)	In newborn Hypochromic type
Physiological (p 1086)	After 2 to 3 months Hypochromic type
Nutritional (p 1087)	After 6 months Hypochromic type in milk fed
Erythroblastosis Foetalis (p 1067)	Hemolytic in newborn Intense jaundice erythroblasts in stained spread Rh factors in maternal and paternal bloods (p 1067)
Sickle Cell (p 10[illegible])	In Negroes Changes in unstained blood (sickling) target cells jaundice splenomegaly leg ulcers
Cooley's Anemia (p 10[illegible]1)	In Mediterranean children Target cells jaundice splenomegaly
Lederer's Anemia (p 1078)	Hemolytic in children Jaundice rapidly progressive anemia
Epidemic Hemoglobinuria (p 10[illegible]6)	In newborn With sepsis urine discoloration jaundice
Congenital Anemia (p 1067)	*In newborn Large liver and spleen but no jaundice* Rh factors (p 1067)
Hemorrhagic Disease of Newborn (p 1111)	Bleeding specific response to menadione (p [illegible]30)
Hemophilia (p 1118)	In males Family history increased coagulation time

LABORATORY EXAMINATIONS

The examinations of specimens obtained from the newborn baby and infant often yield invaluable and pathognomonic diagnostic information In many instances particular skill is required in obtaining the specimen and fine judgment must be exercised in the interpretation of results For this reason the practitioner is often justified in holding consultation with the specialist clinical pathologist so that he may obtain authoritative opinions concerning the clinical problem

LABORATORY EXAMINATIONS IN THE NEONATAL PERIOD AND INFANCY AND CONDITIONS IN WHICH THEY ARE OF DIAGNOSTIC VALUE

Hemoglobin determination (p 3694)

Average of 18 8 gm (120 per cent) at birth with reduction to 12 gm (77 per cent) at 8 months Gradual increase to 12.5 gm (80 per cent) after the first year

Erythrocyte count (p 3692)

Average of 6 000 000 rbc per cu mm at birth with du t on to 4 000 000 at the second or thir l month and a grad ial increase thereafter

Erythroblastos s foetalis

Leukocyte count (p 3692)

Average of 15 000 to 5 000 wbc per cu mm for the first 3 days with a reduction to 10 000 *to 12 000 after the first week*

Lymphocytosis leukocyto is eosinophilia the leukemias

Thrombocyte count (p 3692)

Average 200 000 to 500 000 per cu mm

Thrombocytopenia

Differential count (p 3696)

Average of 75 per cent polymorphonuclears and 25 per cent lymphocytes at b rth At the end of the first few months the polymorphonuclears fall to 25 to 30 per cent and the lymphocytes rise to 65 to 0 per cent

Lymphocytosis polynucleosis eosinophilia abnormal ties of the erythrocytes lymphocytes and leukocytes

Stained smear (p 3692)

Normoblasts and reticulocytes are normally seen for the first week Later the adult, non nucleated erythrocytes prevail

Erythroblastosis foetalis malaria leukemia

Sternal puncture (p 1043)

For the examination of marrow in disturbances of the hematopoietic system

The anemias erythroblastosis foetalis the leukemias Hodgkin s disease mult ple myeloma

Uri e (p 3666)

None for first 8 to 12 hours and then 10 to 15 times daily Particularly seek pyuria and bacilluria in catheterized specimens obtained from female infant Control of micturition between first and second years

Pyuria, bacilluria albuminuria acetonuria glycosuria hematuria hemoglobinuria acute nephritis

Stool examination (p 3727)

Tarry or dark green meconium three to five times in first two or three days Thereafter two or three semi formed yellow or tan movements wh le exclusively on milk diet. Specimen may be concentrated and stained for tubercle bacilli Direct examination for ova and parasites Test for occult blood particularly in hem rrl ag c d sea e of the newborn Acholia in atres a of bile duct M croscopy re eals squamous cells with patency of gastro intestinal tract and excess of fat globules in c liac disease

Melena, fatty stools acholic stools mucus and pus in stools helminthias s celiac d sease ep demic diarrhea, cystic fibrosis of pancreas parenteral diarrhea bacillary dysentery

Gastric and duodenal contents (p 3725)

Test for acid blood enzymes and tubercle bacilli

Occult blood in hemorrhagic diseases of the newborn ac d fast o ganisms n tube culos s cystic fibrosis of pancreas

Cerebrospinal fluid (p 3734)

For cytologic, bacteriologic and serologic examinations

Cerebral and subdural hemor hage encephalitis meningitis pol omyel tis neonatal syph ilis, toxoplasmosis

Mouth smears (p 50)

For demonstration of fungi

Thru h

Cough plate (p 278)

When sputum cannot be obtained

Pertussis and influenza

Throat culture (p 53)

Mandatory in the investigation of follicular and membranous inflammations of oropharynx

Diphtheria streptococcal sore throat, mycotic pharyngitis and tonsillitis Also for pneumococci and meningococci

Vaginal smears (p 2587)

For direct stain and culture

Gonorrheal vulvovaginitis

Conjunctival smears and cultures (p 1546)

For recognition of predominant organisms especially gonococcus

Ophthalmia neonatorum phlyctenular conjunctivitis and syphilitic iritis

Blood chemistry (p 3712)

For determination of calcium carbon dioxide combining power phosphatase cholesterin, protein sugar nitrogen

Hypocalcemia in tetany Changes in CO_2 with acidosis and alkalosis Increased phosphatase in rickets Hypercholesterinemia in hypothyroidism and nephrosis Hypoproteinemia in nephrosis Hyperglycemia in diabetes mellitus Azotemia in nephritis Ascorbic acid in scurvy

Blood culture (p 53)

May be obtained from femoral or external jugular veins Use internal jugular vein or superior longitudinal sinus if other routes are impossible

Sepsis in the newborn cavernous and lateral sinus thrombosis meningococcemia

Serology (p 60)

Complement fixation and agglutination tests for syphilis Comparison of maternal paternal and infant Rh factor in erythroblastosis foetalis

Peritoneal fluid (p 1823)

Obtain by abdominal puncture using apparatus as for diagnostic thoracentesis

Acute peritonitis pneumococcal peritonitis tuberculous peritonitis acute appendicitis nephrotic syndrome

Darkfield microscopy (p 45)

For the definitive diagnosis of syphilis with lesions involving the skin and mucous membrane

Neonatal syphilis

Biopsy

For the histologic study of lesions involving the mucous membranes skin and lymph nodes

In malignancy tuberculosis and chronic granulomatous disturbances

METHODS OF TREATMENT

The technics of therapy in the newborn and infant differ from those employed in the adult The very young child is unable to cooperate in the efforts to provide him with remedial effects he cannot complain when pain or trauma is inflicted he is unable to report discomfort or injury from overheating he struggles against efforts meant for his own best good and makes technical procedures such as intravenous injections exceedingly difficult and at times all but impossible

Nevertheless with the assistance of a skilled nurse or aide a wide variety of therapeutic measures may be employed often with life saving effect and at all times with considerable benefit

METHODS OF TREATMENT IN NEONATAL LIFE AND INFANCY

Suppositories
Insert in rectum for simple constipation

Enemas
Of saline for rectal flush, reserving soapsuds if flush is ineffectual

Inhalations
Of plain steam in all re piratory infections Addition of benzoin unnecessary

Oxygen therapy (p 3827)
In tent or box.

Respirators (p 3 67)
In hospital under expert supervision

Inunctions
Mostly unnecessary since absorption may produce constitutional symptoms particularly with mercury and sulfonamide

Local treatment of nose and throat
Avoid, as instillation of oily drops may produce lipid pneumonitis Painting of nose and throat is uncomfortable and accomplishes nothing Nasal irrigations of value only with tenacious or membranous exudate

Counterirritation
Avoid If necessary heat may be applied with an electric pad on low heat

Hydrotherapy
Sponge bath of greatest value for cleanliness and reduction of temperature Warm tub to bring out eruption in exanthematous diseases and to sedate in convulsive disorders

Heliotherapy (p 3794)
By sunlight or ultraviolet modalities

Compresses and fomentations
Of milk, water or saline solutions for local inflammatory processes

Lavage
Using gavage outfit, to wash out stomach with saline solution

Gavage
Using soft rubber catheter for infant feeding Test for bubbles before introducing fluid.

Nasal feeding
For gavage if tube cannot be passed by mouth

Hypodermoclysis (p 3771)
For introduction of fluid if continuous intravenous drip cannot be set up Use saline or Ringer s solution

Intravenous injection (p 3773)
For small amounts use external jugular scalp wrist or ankle veins or superior longi tudinal sinus

Intravenous drip (p 3775)
If child is seriously ill use scalp vein or cut down on vein and insert cannula to avoid tearing the delicate lining membrane

Transfusion (p 37 8)
Perform as intravenous drip

Intraspinal and intracranial therapy
By lumbar ventricular or cisternal puncture

Ane thesia
Easily nduced in infancy by gaseous gencies

Catheter zation (p 2235)
With small catheter

Roentgen therapy (p 3796)
For neoplasms

TREATMENT WITH DRUGS AND BIOLOGICALS

In the management of diseases of neonatal life and infancy the competence of the physician is measured by the skill with which he uses a few remedies rather than by the variety of his armamentarium In general the pharmacology of early life does not differ qualitatively from that of adolescence and maturity The great difficulty lies in the determination of drug dosage It is our opinion that rules of thumb cannot be formulated for the guidance of the therapist Those based on age and weight do not appeal to us since infants may be highly resistant to one agency and highly susceptible to another Additionally there is the problem of individual idiosyncrasy to be considered and since the practitioner deals with a special infant and not a set of statistics his approach must be that of an experimental pharmacologist Inasmuch as he must usually sacrifice speed of action for safety an initial and small probatory dose is often highly desirable to be followed by increasing amounts if the infant shows neither toxic phenomena nor a satisfactory therapeutic response As a general principle it is suggested that the probatory dose be 10 per cent of the average adult dose The second dose if all goes well may be double the initial amount subsequent doses may be maintained at this level or increased depending upon the urgency of the situation the accuracy with which observations can be made and the therapeutic response

DRUGS AND BIOLOGICALS FOR LOCAL AND SYSTEMIC THERAPY IN THE NEWBORN INFANCY AND CHILDHOOD

Amebicides
Arsenicals iodine oxyquinoline derivatives and emetine (p 527)

Analgesic antipyretics (p 3832)
Acetylsalicylic acid (aspirin) 0 2 to 0 6 gm with 0 1 to 0 3 gm of bicarbonate of soda
Acetophenetidine in same dosage as acetylsalicylic acid for children with idiosyncrasy to aspirin
Sodium salicylate 0.3 to 0 6 gm with 0 2 to 0.3 gm bicarbonate of soda
Ergotamine tartrate (gynergen) 0.25 mg subcutaneously for migrainous headache

Anesthetics general
See p 3923

Anesthetics basal
See p 3841

Anesthetics local
See p 3913

Anions and cations
See p 3823

Anthelmintics
See p 1898

Anticoagulants
Heparin 100 to 200 mg (Loewe) (p 1050)
Dicoumarol 5 mg per kg by mouth with subsequent doses of 1.5 mg per kg daily thereafter (Caution)

Anticonvulsants
Chloral Hydrat 0 0(to 0 18 gm
Paraldehyde 1 to 4 cc in milk or starch paste orally or by rectum
Magnesium Sulfate (2_ per cent) 1 to 2 cc intramuscularly (Caution)

Antidotes
Sodium Formaldehyde sulfoxylate Use 5 per cent solution for gastric lavage and 25 to 50 cc of 10 per cent solution in distilled water for intra enous injection
Universal antidote of 2 gm of pulverized charcoal 1 gm of magnesium oxide and 1 gm of tannic acid to a glass of warm water

Anti infective agents (monovalent)
Quinine quinacrine (atabrine) plasmochin totaquin gold, salicylate iodine oxyquinoline emetine chaulmoogra oil and synthetics (p 881)

Anti infective agents (polyvalent)
Soluble and insoluble sulfonamides Antibiotics including penicillin and tyrothricin (p 106) and streptomycin (p 104) Arsenicals (p 116) and antimony (p 1 ⁹)

Antimalarials
Quinine quinacrine (atabrine) plasmochin and totaquine (p 507)

Antipruritics
See p 2349

Antiparasitics
See p 2"

Antirheumatic remedies
Sodium salicylate (p 194)
Aminopyrine (pyramidon) 0 2 to 0 6 gm (Caution)
Gold Sodium Thiosulfate 10 mg intravenously (Caution)

Bactericides (local)
See p 3113

Biologicals employed in diagnosis
See p 45

Biologicals used for active immunization
See p 4_ *Timetable for Active Immunization* (p 80)

Biologicals for treatment
Human homologous serums (p 82) Heterologous antitoxic serums (p 83) Antibacterial serums for passive immunization (p 84)

Astringents
See p 31_4

Caustics
See p 3092

Antispasmodics
Atropine sulfate 0 032 to 0 0(mg (1 9000 to 1 1000 grain)
Novatropine 1 mg
Tincture of Belladonna 0.3 cc
Theophylline-ethylene diamene (aminophylline) 0 1 gm combined with phenobarbital 0.08 gm and ephedrine sulfate 0 025 gm in capsules For intravenous use employ 0.3 cc from sterile ampoule
Ephedrine Sulfate 15 to 50 mg
Propadrine Hydrochloride 25 mg
Epinephrine Hydrochloride (1 1000) 0 2 to 0.3 subcutaneously Epinephrine in Oil 0.3 to 0 cc intramuscularly
Oenethyl o to 10 mg orally or subcutaneously
Mecholyl 25 mg orally or intramuscularly (Caution)

Roentgen therapy (p 3796)
For neoplasms

Treatment with Drugs and Biologicals

In the management of diseases of neonatal life and infancy the competence of the physician is measured by the skill with which he uses a few remedies rather than by the variety of his armamentarium In general the pharmacology of early life does not differ qualitatively from that of adolescence and maturity The great difficulty lies in the determination of drug dosage It is our opinion that rules of thumb cannot be formulated for the guidance of the therapist Those based on age and weight do not appeal to us since infants may be highly resistant to one agency and highly susceptible to another Additionally there is the problem of individual idiosyncrasy to be considered and since the practitioner deals with a special infant and not a set of statistics his approach must be that of an experimental pharmacologist Inasmuch as he must usually sacrifice speed of action for safety an initial and small probatory dose is often highly desirable to be followed by increasing amounts if the infant shows neither toxic phenomena nor a satisfactory therapeutic response As a general principle it is suggested that the probatory dose be 10 per cent of the average adult dose The second dose if all goes well may be double the initial amount subsequent doses may be maintained at this level or increased depending upon the urgency of the situation the accuracy with which observations can be made and the therapeutic response

Drugs and Biologicals for Local and Systemic Therapy in the Newborn Infancy and Childhood

Amebicides
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Analgesic antipyretics (p 3832)
Acetylsalicylic acid (aspirin) 0.2 to 0 6 gm with 0 1 to 0.3 gm of bicarbonate of soda
Acetophenetidine in same dosage as acetylsalicylic acid for children with idiosyncrasy to aspirin
Sodium salicylate 0.3 to 0 6 gm with 0.2 to 0.3 gm bicarbonate of soda.
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Anesthetics general
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See p 3841

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Anions and cations
See p 3823

Anthelmintics
See p 1898

Anticoagulants
Heparin 100 to 200 mg (Loewe) (p 1050)
Dicoumarol 5 mg per kg by mouth with subsequent doses of 1.5 mg per kg daily thereafter (Caution)

Laxatives and cathartics
- Liquid Petrolatum (Mineral Oil) 4 to 15 cc
- Emulsion of Liquid Petrolatum (Petrolagar) 4 to 15 cc
- Compound Mixture of Rhubarb (Rhubarb and Soda) 4 cc
- Milk of Magnesia 4 cc
- Fluid Extract of Cascara Sagrada 4 cc
- Magnesium Sulfate (Epsom salts) 15 to 30 cc

Protectives and lubricants
- See p 3152

Leukocyte stimulants
- Pentnucleotide 10 cc intramuscularly

Miotics
- See p 1548

Mydriatics
- See p 1548

Opiates and substitutes
- Codeine Sulfate or Phosphate 4 to 10 mg orally or subcutaneously
- Morphine Sulfate 2 to 8 mg subcutaneously
- Camphorated Tincture of Opium (Paregoric) 2 to 8 cc
- Dilaudid 0.25 to 0.5 mg
- Demerol 10 to 25 mg

Peristaltic stimulants
- Neostigmine Methyl Sulfate (1 4000) 0.25 to 0.5 cc intramuscularly
- Posterior Pituitary Extract 0.2 to 0.3 cc intramuscularly

Sedatives and hypnotics
- Chloral Hydrate 0.2 to 0.3 gm
- Sodium Bromide 0.3 to 0.6 gm
- Phenobarbital 16 to 32 mg
- Sodium Phenobarbital 8 mg intravenously in sterile water
- Amytal 0.06 gm in capsules or 5 mg of sodium salts per Kg intravenously up to 0.24 gm.
- Sodium Pentobarbital (nembutal) 0.04 to 0.1 gm

Spirochetcides
- See *Penicillin* (p 108) *Arsenicals* (p 116) *Bismuth* (p 126) and *Mercury* (p 1 0)

Test substances
- Barium Sulfate 300 gm in 400 cc of water for contrast roentgenography
- Bromsulfalein 2 mg per Kg intravenously for liver function test
- Decholin 3 to 5 cc intravenously for arm to tongue test of circulation time (p S)
- Diodrast for intravenous urography Use 5 cc up to 6 months 7 cc from the 6th to the 12th month 10 cc from the 1st to the third year and 20 cc after the age of 7
- Galactose for tolerance test Use 5 cc of 20 per cent solution in newborn and 10 to 15 cc in older children
- Dextrose tolerance test Give 2 gm per Kg up to 50 gm orally Inject 0.5 cc per Kg of 20 per cent solution intravenously
- Lipiodol 1 to 5 cc by local instillation for bronchoscopy and outlining of cavities
- Phenolsulphthalein (1 cc equals 6 mg of dye) Inject 1 cc intramuscularly

Urinary antiseptics
- See p 2256

Cerebral stimulants

Amphetamine Sulfate (Benzedrine) 1 to 2.5 mg

Circulatory and respiratory stimulants

Digitalis 0 03 gm per Kg for saturation dose and 0 1 gm daily for maintenance dose

Quinidine Sulfate 0 1 gm three times daily

Caffeine and Sodium Benzoate 0 03 to 0 06 gm subcutaneously

Alpha lobeline 0.2 to 0 6 cc intravenously

Nikethamide (coramine) 1 5 cc subcutaneously

Metrazol 1 cc of 10 per cent solution intravenously

Strychnine Sulfate 1 to 1.5 mg subcutaneously

Collyrium

See p 1548

Diuretics

See p 2257

Emetics

See p 1757

Epithelial stimulants

See p 3129

Expectorants

Liquor Ammoniae Anisatis 2 cc in one quarter glass of water

Elixir Terpene Hydrate and Codeine (4 cc contains 8 mg of codeine)

Hematinics

See p 1059

Hormones and antihormones

Anterior pituitary growth hormone 0.5 to 1 cc

Anterior pituitary like sex hormone (follutein) 100 to 200 units three times weekly

Thyroid Extract 6 to 60 mg as indicated by basal metabolic rate

Estrogen Use diethylstilbestrol 0 25 to 0 5 mg orally intramuscularly or by vaginal suppository

Insulin and Protamine Zinc Insulin Dose according to need (p 1237)

Liver Extract 1 cc intramuscularly

Solution of Parathyroid Extract (Parathormone) 5 to 10 units subcutaneously or intramuscularly (1 cc equals 100 U)

Pancreatin 0 3 to 1 0 gm in each 180 cc of feeding formula

Solution of Posterior Pituitary Extract 0 2 to 0.3 cc intramuscularly or Pitressin Tannate in Oil intramuscularly

Compound Solution of Iodine (Lugol) 0 06 to 0 6 cc for antithyroid effect

Deracil 10 to 30 mg as antithyroid agent

Intravenous fluids

Physiological Saline

5 to 50 per cent Dextrose in distilled water or physiological saline

Plasma (p 3708)

Typed Citrated Human Blood (p 3710)

Amino Acids (10 per cent) 2 2 gm per Kg

5 per cent Sodium Bicarbonate (0.5 gm per Kg raises the CO_2 15 volumes per cent)

Sodium r lactate (Hartmann) 30 cc of ⅙ molar solution raises the CO 15 volumes per cent

Keratolytics

See p 3137

CHAPTER 128

HYGIENE AND CARE OF THE NEWBORN THE FEEDING OF INFANTS AND CHILDREN

ORGANIZATION OF THE HOSPITAL NURSERY

The increased tendency to hospital deliveries has created a need for uniform methods in the care of newborn infants The Department of Health of the City of New York has published a resume of suggestions in this regard

The Nursery —1 Each hospital institution home or place for the delivery and care of pregnant women must maintain in good order two regularly constituted *nurseries* One is used for *normal newborn babies* and the other for the segregated care of *prematurely and immaturely born infants* and those who suffer from some *congenital debility*

2 Separate facilities are to be present at all times for the complete *isolation* of infected and ill babies

3 The nursery must be located as near as possible to the maternity ward and proper attention is to be given to the factors of light fresh air temperature and humidity control

4 There should be a minimum of two feet of space around each bassinette on all sides The suspension of each bassinette on double-decked racks or wall locks is prohibited and wherever possible individual *cubicles* are advised

5 Easily sterilized folded *blankets* are used instead of mattresses Common dressing or diapering tables are prohibited Properly labeled individual equipment such as thermometers and baby utensils are provided for each baby and kept at the bedside Common or group carriers for taking newborn children to the mother are prohibited Adequate equipment is to be available for the sterilization of all nursing room utensils as well as containers for soiled linen and diapers Facilities are to be available for the proper disposal of waste Examining instruments are to be thoroughly sterilized after use on each baby No dry dusting or sweeping is permitted in the nursery Cleaning is to be done while the children are out during the hours of feeding

6 The nursery *laundry* is to be washed and sterilized separately from the laundry of other hospital divisions and by a different laundry crew The formula kitchen is to be entirely divorced from any diet kitchen There must be adequate means for the refrigeration of milk and formulas Autoclaves are to be made available for bottles nipples bottle caps and utensils used in preparing the formula

Vaccines

See p 77

Vasoconstrictors

Privine 0 05 per cent Neosynephrine 0 25 to 0.5 per cent Ephedrine Sulfate 1 to 2 per cent Cocaine Hydrochloride 1 to 4 per cent Epinephrine 1 1000 Amphetamine Sulfate 1 per cent

Vitamins

See p 617

Clothing
Use only band diaper and shirt of wool or cotton Stockings optional Avoid overdressing and overheating

Nursing care
Attendant to scrub hands before approaching infant and wear mask when nearing bed Mother to wear mask during nursing or feeding

Care of mouth
Swab digitally or with applicator Give water after each nursing or feeding

Care of eyes
At birth cleanse with saline followed by prophylactic instillation of 1 per cent silver nitrate or penicillin (1 cc = 500 units) Thereafter avoid unnecessary manipulation unless lids appear crusted

Care of prepuce
Keep clean until circumcision (p 3336) on ninth or tenth day Retract foreskin daily break adhesions gently

Identification tag
To avoid confusion in nursery

Birth certificate
To be given parent immediately after filing

Skin
1 Wipe vernix caseosa off scalp and face at birth but do not remove remainder for 7 days Apply oil to inguinal folds and buttocks twice daily Avoid bath for a week after which vernix is removed and a warm tub is given daily or every second day using soap on scalp but nowhere else
2 Remove vernix completely at birth and bathe child daily or every other day Dry and dust with talc removing excess particularly in folds

Prevention of hemorrhagic disease
1 to 2 mg menadione intramuscularly if mother has not received vitamin K during pregnancy

Head of bed
Lower if respirations are irregular and shallow Elevate in suspected intracranial bleeding

Feeding
Infant at 30° angle with head elevated Holes in nipple of proper size Watch for tiring of infant Bubble infant frequently

FEEDING OF THE NORMAL INFANT

Breast Feeding —Of late there has been a deplorable tendency to minimize the importance of breast feeding With the introduction of newer methods of artificial feeding and many proprietary infant foods the impression has gained currency that artificial feeding is just as good It

7 The formulas are to be simple and as few procedures as possible are performed in their preparation Accessory rooms are provided for ritual circumcision A glass partition is to be made available to protect the child from visitors

The Nursing Staff —The newborn service is to have its own *nursing staff* which is distinct from the maternity service The *nurses* are to be specially trained for care of the newborn and in the technic of *aseptic nursing* (p 2748) Each nursery is to have its own quota of nurses who are not per mitted to do duty on any other branch of the maternity service or in any other ward of the hospital Neither are these women permitted to pass from one nursery to another in order to avoid any possibility of cross infection

If possible there is to be one nurse for each two babies in the nursery day and night Separate nursing staffs are to be maintained for premature babies for those who are ill and in the isolation portion

Aseptic Nursery Technic.—Aseptic nursery technic requires that each person in the nursery be supplied with a *sterile gown cap* and *mask* At tendants who handle babies are to scrub their hands before passing from one child to another Any positive evidence of lues or recent history of an upper respiratory infection gastro intestinal disturbance or pyoderma excludes that person from service in the nursery Cultures of the nose throat and stool are to be made monthly in order to detect *carriers* The mother is to be included in the routine of aseptic nursing and at no time should she be permitted to break technic nor should the baby be brought to its mother if she is ill from any cause whatsoever

THE HYGIENE OF THE NEWBORN

The care of the newborn child is the province of the practitioner obstetrician Many exigencies require emergency treatment administered with great skill to accomplish therapeutic purpose without inflicting dam age which may produce irreparable handicap in later life

Clear air passages

Suspend infant by feet Clear trachea digitally Aspirate mucus with bulb catheter

See *Asphyxia Neonatorum* (p 2766)

Prevention of atelectasis

By inhalations of 5 to 15 per cent CO_2 for five minutes every four hours for the first 12 hours Encourage crying

Care of umbilicus

If ergonovine has been used cord may be clamped after a few mo ments Otherwise ligature is not applied until pulsations have weak ened or disappeared waiting 10 to 30 minutes to permit auto transfusion from placenta Cord is ligated and divided between ligatures about ½ inch from the skin margin A dry dressing is applied with pressure After 4 to 6 days stump sloughs off leaving a small ulcerated area which requires only a protective ointment and a sterile dressing

Clothing
Use only band diaper and shirt of wool or cotton Stockings optional Avoid overdressing and overheating

Nursing care
Attendant to scrub hands before approaching infant and wear mask when nearing bed Mother to wear mask during nursing or feeding

Care of mouth
Swab digitally or with applicator Give water after each nursing or feeding

Care of eyes
At birth cleanse with saline followed by prophylactic instillation of 1 per cent silver nitrate or penicillin (1 cc = 500 units) Thereafter avoid unnecessary manipulation unless lids appear crusted

Care of prepuce
Keep clean until circumcision (p 3936) on ninth or tenth day Retract foreskin daily break adhesions gently

Identification tag
To avoid confusion in nursery

Birth certificate
To be given parent immediately after filing

Skin
1 Wipe vernix caseosa off scalp and face at birth but do not remove remainder for 7 days Apply oil to inguinal folds and buttocks twice daily Avoid bath for a week after which vernix is removed and a warm tub is given daily or every second day using soap on scalp but nowhere else
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Infant at 30° angle with head elevated Holes in nipple of proper size Watch for tiring of infant Bubble infant frequently

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Breast Feeding.—Of late there has been a deplorable tendency to minimize the importance of breast feeding With the introduction of newer methods of artificial feeding and many proprietary infant foods the impression has gained currency that artificial feeding is just as good It

should be emphasized that breast feeding still remains the optimum method of feeding It has long been noted that the milk of every mammal is specific for the young Human milk is meant for babies cow's milk for calves

Probably one of the greatest advantages of breast feeding is the elimination of the danger of bacterial contamination Maternal milk is practically sterile and is delivered directly from the producer to the consumer The dangers of faulty refrigeration or sterilization and of errors in making the formula are also avoided The mother is furthermore relieved of the daily burden of washing and sterilizing bottles and nipples and of composing the formula

Breast milk is ideally suited for the nutritional needs of the infant The *protein carbohydrate* (chiefly lactose) and *fat* are readily digested and absorbed The *mineral salts* while smaller in amount than in cows milk are better utilized (See *Chemical Composition of Milk* (p 634)) Iron and vitamin D are present in a quantity that is lower than the optimal requirements of the infant Vitamins C and B may be deficient unless the mother takes an adequate diet

It is therefore the duty of the physician to acquaint the mother with the advantages of breast feeding and to urge her to nurse her baby The only contraindications to nursing are active *tuberculosis whooping cough* at the time of delivery *early syphilis* in the mother with the infant apparently free of infection and acute debilitating illness in the mother (e g *sepsis pneumonia eclampsia*)

With an inadequate breast milk supply if the physician wishes to furnish breast milk for a premature infant or for any other nutritional problem he may resort to the use of a *wet nurse* or to a *breast milk bureau* Many of the larger communities have organized the latter type of agency where breast milk is obtained from carefully selected donors Canned preserved breast milk has also been employed for infant feeding but it is not clear as yet as to the efficacy of its use

Nursing Schedules—The time for the first feeding after birth varies with the extent of the ordeal during delivery to mother and baby Ordinarily the infant is put to the breast about twelve hours after birth and every four hours thereafter Although the infant obtains only small amounts of *colostrum* for the first day or two the early feedings stimulate the secretion of milk and accustom mother and child to the nursing procedure

Both breasts are offered to the infant for ten minutes at each feeding If the infant cries inordinately because of a scant milk supply or if there is an excessive loss of weight during the neonatal period 5 per cent glucose solution is given after each feeding (See table, p 2753) The infant may be weighed before and after each feeding to determine the quantity of milk ingested in cases where the adequacy of the supply of breast milk is questioned

After the third day five or six feedings in twenty four hours should suffice If the milk flow is *abundant* only one breast is used at each feeding to diminish the danger of cracked and sore nipples The total duration of feeding in either case should be no more than 20 minutes since the infant obtains most of the milk during the first few minutes

The *night feeding* can usually be omitted after the first two weeks or a month enabling the mother to obtain an eight hour rest period Some infants require more frequent feedings due to scant milk supply or feeble suckling In such instances a three hour schedule is employed with seven or eight feedings daily

Hygiene of Nursing —Care of the Breasts The nipples are washed with boiled water or saline solution before nursing Chafing of the nipples by external irritation or clothing is avoided A soft macerated nipple can often be hardened by boric acid solution in 50 per cent alcohol

Lead nipple shields should never be used because of the danger of lead poisoning to the suckling *Retracted nipples* often can be brought forward by the use of a breast pump

Complications of Breast Feeding —Unsuccessful Nursing Every effort is made to obtain an adequate supply of milk before weaning is advised Too often extraneous symptoms are ascribed to breast milk and the infant is taken off the breast If the quantity of milk is sufficient the quality of the milk is almost certainly satisfactory

A breast fed infant who is not obtaining enough milk is irritable flatulent and fails to gain weight The stools are frequent small and green in color The baby is weighed before and after feedings to determine the amount ingested and if it is insufficient either supplementary or complementary artificial feedings may be given

Overfeeding is a less difficult problem It is manifested by regurgitation colic or vomiting If feeding time is diminished the milk supply soon regulates itself

Addition of other *foods* and *vitamins* is advised as in the artificially fed infant (See *Supplementary Feeding* (p 2755)) The substitution of an occasional artificial feeding adds to the convenience of the mother if this is not done frequently enough to endanger the quantity of milk secretion

Weaning—Since the early months of breast feeding are most important weaning should not be begun earlier than is necessary As a general rule weaning can best be started from the seventh to the ninth month Weaning is done gradually if possible to avoid discomfort to the mother and to accustom the infant to the new type of milk With the introduction of supplementary foods and a decrease in the frequency of the nursing there is a spontaneous decrease in the amount of milk secretion One breast feeding at a time may be replaced by a cow s milk formula and the resultant decrease in stimulation of the breast will gradually decrease the flow of milk

Artificial Feeding —*Calculation of the Nutritional Requirements of the Infant* —The subject of artificial feeding of infants has suffered greatly from over dogmatism There are numerous satisfactory methods of feeding infants It should be emphasized that *the baby is an individual* The requirements calculated are merely an *average value* and the normal infant may need more or less than the average requirement

Cow s milk is the principal article of food in the dietary of the artificially fed infant In order to approximate the chemical composition of mother s milk cow s milk is modified by dilution with water and the addition of sugar

The average infant requires *45 to 50 calories per pound* or 100 calories

per kilogram of body weight One and one half to two ounces of milk are allowed per pound of weight to supply the necessary amount of *protein fat and minerals* *Carbohydrate* is added in sufficient quantity to make up the remaining calories, the amount being calculated on the basis of $\frac{1}{10}$ ounce of lactose per pound of body weight If the formula is made nearly iso caloric with breast milk *i e* 20 calories per ounce the fluid intake requires no further consideration

The number of daily feedings and the amount in each bottle determine the resultant formula Most artificially fed infants do well with a *four hour schedule* although occasionally a small or apathetic infant requires more frequent feedings

As soon as the infant begins to sleep through the night without awak ening five feedings per day are given At the fifth or sixth months the bottles may be reduced to four per day

The *amount of milk* in each bottle is patterned after the average good flow of breast milk It may be calculated on the basis of the fluid requirements which approximate 2 to 3 ounces of water per pound of body weight

TABLE 147—APPROXIMATE QUANTITIES OF MILK FROM ONE NURSING

	Quantity of Milk (Ounces)
During the first week	1 to 1½
During the second week	1 to 3
During the fourth week	4½
During the sixth week	5
During the third month	5½
During the fourth month	6
During the sixth month	7

As a rule no more than seven ounces are given in each bottle The volume of the feedings is adjusted to the infant s inclinations

Sample Calculation—The formula for a three month infant weighing 12 pounds to be artificially fed

Caloric Requirement 45 calories per pound × 12 pounds = 540 calories
Milk 1½ to 2 ounces per lb = 18 to 24 ounces or an average of 21 ounces = 420 calories
Sugar 540 cal − 420 cal = 120 cal = 1 ounce cane sugar (2 tbsp)
Water To make 5½ ounces for five feedings = 27½ ounces Add 6½ ounces of boiled water Additional water is added to allow for loss in boiling formula

The Type of Carbohydrate or Sugar Used in the Formula—Lactose cane sugar dextrin maltose preparations and honey are used to supply added carbohydrate in the formula

LACTOSE—Lactose or milk sugar ferments more readily than other forms of sugar It may give rise to diarrhea

CANE SUGAR—Cane sugar is the most easily available and cheapest of the carbohydrates It is used most extensively for routine feedings It is the sweetest of the sugars an advantage when small amounts are to be fed but undesirable for feedings high in carbohydrates It ferments less readily than lactose

DEXTRIN MALTOSE PREPARATIONS —In the conversion of starch by the enzymatic action of diastase or by acid hydrolysis the successive stages of dextrin maltose and finally dextrose are reached In the manufacture of the dextrin maltose preparations the process is stopped short at stages which contain various amounts of dextrins maltose and dextrose The dextrins are slowly converted into dextro e by the intestinal enzymes The dextrose is absorbed at a rate equal to its formation so that there is little available for fermentation This is advantageous in the treatment of *diarrheal states* Maltose is readily fermented and as such is laxative

Among the most common dextrin maltose preparations are Mead Johnson s Dextri maltose Mellin s food Karo syrup Cartose and Dexin (Burrough s Wellcome)

APPROXIMATE MEASURES

	Level Tablespoonfuls	*Ounces*	*Calories*
Cane sugar	2	1	120
Milk sugar	3	1	120
Dextri maltose	4	1	110
Karo corn syrup	1½	1	90

HONEY —Honey contains levulose dextrose and sucrose It has no special beneficial advantages

Preparation of the Formula APPARATUS —Apparatus for the preparation of the formula should be kept together and not used for any other purpose

1 *Nursing bottles* of eight ounce capacity Pyrex or heat resistant glass
2 *Nipples* of a type that can be easily cleaned The holes in the nipples should be regulated so that the milk drops freely A freshly boiled nipple is used for each bottle
3 *Cover jar* for holding nipples
4 *Forceps* or teaspoon for handling nipples
5 *Rubber caps* for bottles
6 *Brush* for washing bottles
7 *Measuring spoon*
8 *Glass graduate* holding 32 ounces
9 *Funnel*

MAKING THE FORMULA —Before use utensils employed in the preparation of the formula are sterilized for five minutes If there is adequate facility for refrigeration the formula for twenty four hours is prepared

After measuring the prescribed amounts of milk boiled water and sugar into the graduated cylinder the contents are poured into a saucepan or double boiler and boiled for five minutes The formula is poured into the bottles and the bottles stoppered If bottle rack and large pot are available the formula is sterilized in the bottles After the bottles cool they are placed in the refrigerator and kept there until they are used

Other Milks and Milk Products Used in Infant Feeding *Evaporated Milk* — Evaporated milk is cow s milk with approximately 50 per cent of the water removed It is sterile The composition is standardized by government requirements The milk is homogenized so that the curd is softer and finer than that of boiled cow s milk

Evaporated milk thus presents advantages over whole cow's milk for infant feeding It has no disadvantages There are 44 calories per ounce

Condensed Milk—Condensed milk should not be confused with evaporated milk Here too the milk has been evaporated to half the original volume, but 43 per cent cane sugar is added The carbohydrate content is excessive for routine infant feeding

Goat s Milk—Goat's milk approximates cow's milk in composition It is used in localities where cow s milk is not available It is also employed in feeding infants who are *allergic to cow s milk* It is obtainable in evaporated form (Meyenberg s evaporated milk Caprilac)

Acid Milks—Milk is acidified chemically or by fermentation The routine employment of acidified milk is advocated by some who claim the following advantages

1 Protein is made more digestible by acid coagulation
2 Bacterial growth is inhibited
3 Acidity overcomes the high buffer value of cow s milk
4 Acidity favors the absorption of calcium

The stated advantages have not been sufficiently proven to justify the greater labor and expense associated with the preparation of acid milks

Dried or Powdered Milk—Dried or powdered milk prepared by the spray or roller process is a fine flaky powder produced by the volatilization of the water content The best known of the dried products are Merrell Soule's *Klim* and Mead s *Powdered Whole Milk*

Dryco is a dried milk from which two thirds of the fat is removed before drying

The dried milks have little advantage over evaporated milk

Complete Formula Milks—Powdered milk preparations have been modified so as to simulate mother s milk and improve upon some of its deficiencies in vitamins and minerals These products have the advantage of simplicity They are more expensive than whole or evaporated milk formulae

S M A is skimmed cow s milk fortified with a *potassium salt* and sufficient *lactose* to approach the composition of mother s milk A mixture of *cod liver oil* with vegetable and animal fat has been homogenized and incorporated to the proportion of 4 per cent An *iron salt* is added to correct the iron deficiency Three and one half tablespoonfuls of S M A are equal to an ounce and equivalent to 140 calories In preparation one tablespoon of the powder is added to two ounces of water

Other complete formula dried milks of similar composition are *Lactogen* (Nestle s Milk Products Company) and *Similac* (M & R Dietetic Laboratories) In *Olac* (Mead Johnson) *casein* has been added The fat is mainly *olive oil* with a supplement of *fish liver oil* Olive oil has been reported to be better utilized than cow s milk fat by the newborn and premature infant

Biolac is a liquid one formula milk with supplements of *lactose vitamins* and *iron* It is easily prepared for feeding by dilution with an equal volume of boiled water

Soy Bean Milk is used for feeding infants who are *allergic to cow s milk* Mull Soy (Muller Laboratories) is a mixture of soy bean flour soy bean oil dextrose sucrose calcium phosphate calcium car[illegible]te and

sodium chloride It is a liquid which is prepared for feeding by the addition of an equal amount of boiled water

Sobee (Mead Johnson) is a powdered soy bean preparation prepared for feeding by adding 6 level tablespoonfuls to seven ounces of water

Supplementary Feeding During the First Year of Life —*Cod Liver Oil* —At about two weeks of age cod liver oil or some other form of vitamin D concentrate is started A few babies are upset by cod liver oil A few drops are given as a probatory dose which is then increased to 2 to 3 teaspoonfuls daily While cod liver oil has the advantage of low cost the concentrated fish oils and synthetic preparations are more potent and palatable The premature infant and the rapidly growing infant require a larger dose of vitamin D than the average infant

Orange Juice —During the first month orange juice is added to the diet beginning with a half teaspoonful daily and gradually increasing the amount to one ounce Two ounces of *tomato juice* are substituted if this is more readily available

If the juices are too laxative 25 to 50 mg of *ascorbic acid* are prescribed instead

Cereal —Cereal is added to the diet at about the third or fourth month Farina hominy cream of wheat or ground rice is employed Later whole grained cereals are substituted

The precooked cereals prepared especially for infants are somewhat more expensive but very convenient They require merely the addition of water or milk before feeding

Minerals and some vitamins are usually added to these preparations in manufacture Pablum (Mead Johnson) Cerevim (Lederle) and Gerber s Cereal are the most frequently employed of the precooked cereals Usually one tablespoonful is given with the mid morning feeding at the start and the amount is gradually increased until 3 to 4 tablespoonfuls are given twice daily

The solid foods are fed with a spoon before the breast or bottle feeding Toast Zweiback or soda crackers softened in hot milk may be substituted for cereal at the sixth month

Vegetables —Pureed vegetables are given with the early afternoon feedings at about the fourth or fifth month They should be well cooked in a small amount of water so that the juice can be incorporated in the puree One vegetable at a time may be introduced although variety in the diet is not an important consideration

The *canned pureed vegetables* are highly satisfactory for infant feeding Potato may be started at the sixth month

Egg —At the fifth or sixth month egg yolk is fed with the early afternoon feeding Since this is frequently associated with allergic reactions only a small amount is given for the first week and if there is no untoward effect an entire egg yolk may then be offered

The egg white (albumen) is more highly antigenic than the yolk so that feeding of an entire egg is postponed until after the first year

Fruits and Desserts —Mashed *banana applesauce prune* and *apricot* puree are usually well tolerated They are started at the fifth or sixth month *Junkets custards* and *milk puddings* are given soon thereafter

Meats —At the seventh or eighth month *liver mash* and scraped beef

are introduced to the diet at luncheon and may then be alternated with egg yolk

As soon as some of the teeth have erupted ground *white meat of chicken bacon* or finely chopped broiled *lamb chop* may be substituted

During the second half of the first year with the gradual introduction of the *solid foods* the calculation of the diet in terms of calories becomes unnecessary except in special feeding problems Feeding in accordance with the appetite is satisfactory for the vast majority of infants beyond this age The only food usually taken in excess is milk and no more than one quart of milk per day should be prescribed

The breast fed infant is *weaned* during the second half of the first year (p 2751) With the artificially fed infant the added sugar in the formula is gradually diminished until *whole milk* is given at about the *sixth* or *seventh* month

TABLE 148 —SAMPLE DIET FOR A NINE MONTH INFANT

Breakfast	(7 A.M.)	Cereal 3–4 tablespoonfuls
		Milk, 8 ounces Some is added to the cereal
		Egg yolk
	(9 A.M.)	Juice of one orange
		Cod liver oil 3 teaspoonfuls
Lunch	(12 noon)	Scraped beef or liver mash
		Green vegetable 2 tablespoonfuls
		Potato 2 tablespoonfuls
		Dessert
		Milk 7–8 ounces
Supper	(6 P.M.)	Cereal 3–4 tablespoonfuls
		Milk 8 ounces
		Fruit (mashed banana or applesauce)

The Diet from the First to the Second Birthdays —From the first to the second birthdays the diet undergoes very little change The variety of foods is increased with only one new food added at a time to rule out *hyper sensitivity* The quantities permitted will be larger to allow for added weight and increased energy expenditure since the child is beginning to walk and run about

Three meals a day are given and nothing is fed between meals

DIET IN CHILDHOOD

The Diet from the Second to the Third Birthdays —The diet at two and three years of age contains all the foods given before this age with several additions For the child who is very hungry an afternoon feeding of milk and bread and butter may be allowed

Breakfast	Choice of fruit (orange applesauce prunes grapefruit or baked apple)
	Cereal (any cooked cereal with milk and sugar)
	One cup of milk
	One slice of bread with a teaspoonful of butter
Dinner	One half cup of vegetable soup containing an additional two tablespoonfuls of vegetables
	One medium potato
	Six tablespoonfuls of green vegetables (spinach string beans green peas carrots or beets)

	One slice of bread
	A dessert (fruit fresh or stewed or pudding)
	One half cup of milk.
Afternoon Feeding	Milk with bread and butter
Supper	One egg
	One slice of bread with a teaspoonful of butter
	One cup of milk
	A dessert as at luncheon

The Diet from Three to Six Years —A satisfactory well mixed diet to be started at the third year of life is outlined below

Breakfast	Fruit (orange applesauce prunes one half grapefruit or a baked apple)
	Cereal (one half cup with four ounces of milk and two teaspoonfuls of sugar)
	One cup of milk
	One to two tablespoonfuls of cod liver oil
	One slice of bread with a teaspoonful of butter
Dinner	Vegetable soup one half cup with additional two tablespoonfuls of vegetables
	Meat and fish four level tablespoonfuls
	One medium potato
	Six tablespoonfuls of a green vegetable (spinach string beans green peas carrots beets)
	One slice of bread with a teaspoonful of butter
	Dessert choice of fruit, fresh or stewed or pudding
	One-half cup of milk
Afternoon Feeding	Bread and butter with milk
Supper	One egg
	Vegetable or soup if desired
	One slice of bread with butter
	One cup of milk
	Dessert

The Diet Until Puberty —The essential diet remains the same as that set forth previously but undergoes quantitative changes A well balanced diet containing the dietary essentials as set forth for the adult is the aim

Children may be especially fond of one food and fill up on it to the exclusion of adequate amounts of meat vegetables or fruit

The child should be given his meals at regular intervals and should never be forced to eat To the contrary the child who is refusing his food should be given one half or less of his original servings until he is hungry again If the appetite is not thus stimulated a search for other causes is undertaken (p 1779)

Certain foods are avoided throughout childhood Other foods are given only rarely and in minute portions The following list may serve as a guide to this category Chocolates and candy soda water coffee tea waffles fritters pancakes and hot breads cucumbers and radishes spiced foods sausages and bologna rich pies pastries and cake vinegar pickles spiced cheeses (cottage and cream cheese excepted)

CHAPTER 129

CLINICAL DISTURBANCES OF THE NEONATAL PERIOD INFANCY AND CHILDHOOD

The clinical abnormalities of the neonatal period and infancy result from congenital anomalies birth traumas neoplastic disease metabolic disturbances local infections and systemic invasions Those disturbances which are peculiar to early life alone are described in the present chapter Most disturbances may occur in all age groups however and they are therefore discussed in appropriate sections throughout these volumes They are listed below with page references for the reader s convenience

Systemic Infections

Staphylococcemia (p 153) Streptococcemia (p 2 8) Acute Rheumatic fever (p 186) Pneumococcemia (p 204) Meningococcemia and meningococcus meningitis (p 08) Gonococcemia and gonorrheal vulvovaginitis (p 2586)) Bacillary dysentery (p 943) Tuberculosis (p 252) Pertussis (p 2 8) Influenza (p 396) Tetanus (p 294) Gas gangrene (p 300) Diphtheria (p 302) Neonatal syphilis (p 2 87) Rat bite fever (p 363) The common cold (p 391) Atypical pneumonitis (p 218) Measles (p 409) Rubella (p 417) Fourth disease (p 418) Fifth disease (erythema infectiosum) (p 418) Sixth disease (erythema subitum) (p 419) Chickenpox, smallpox, vaccinia (p 428) Herpes simplex and zoster (p 433) Inclusion blennorrhea (p 1623) Lymphocytic choriomeningitis (p 448) Acute anterior poliomyelitis (p 457) Post infectious encephalitis (p 445) Infectious mononucleosis lymphocytosis and leukopenia (p 466) Mumps (p 480) Malaria (p 507) Amebiasis (p 5 3) Toxoplasmosis (p 58)

Allergies

Atopic dermatitis (p 3342) Vasomotor rhinitis (p 2098) Urticaria (p 3345) Angioneurotic edema (p 3349) Bronchial asthma (p 2101)

General Metabolic Diseases

Malnutrition (p 2 83) Marasmus (p 2783) The avitaminoses especially rickets (p 2850) scurvy (p 2857) and hemorrhagic disease of the newborn (p 1111) Tetany of the newborn (p 27 8) Acidosis and alkalosis (p 721) Hypocalcemia (p 24) Hypo-

proteinemia (p 706) Azotemia (p 2276) Hyperglycemia (p 733) Infantilism (p 693) Giantism (p 1155) Von Gierke's disease (p 1978) *The reticulo-endothelioses or lipoidoses* (p 1133) *Carotinemia* (p 620) Asphyxia of the newborn (p 2766) Prematurity (p 2763)

Circulatory Disorders

Congenital anomalies (p 953) *Idiopathic hypertrophy* of the heart (p 867) Pericarditis (p 1007) Cavernous sinus thrombosis (p 1447) Lateral sinus thrombosis (p 1447) Acute and subacute endocarditis (p 1020)

Endocrinopathies

Cretinism (p 1191) Anterior pituitary disorders (p 1164) Diabetes insipidus (p 1180) Persistence of the thymus (p 1246) Hyperpinealism (p 1185) Pubertas praecox (p 2418) Masculinization in the female (p 2487) Feminization in the male (p 2481) Infantilism (p 693) Giantism (p 1155) Hypogonadism (p 2412) Hyperestrogenemia (p 2778) *Parathyroid tetany* (p 1232)

Hematologic disorders

Anemias (p 1055) Leukemias (p 1100) Thrombocytopenic purpura (p 1114) Hemorrhagic disease of the newborn (p 1111) Lipoidoses (p 1133) Icterus neonatorum (p 1067) Erythroblastosis foetalis (p 1067) Hemorrhagic diatheses including hemophilia (p 1108) Splenomegaly (p 1131) *Lymphadenopathy* (p 11 6) *Hodgkin's disease* (p 1138)

Psychiatric and Neurologic Disturbances

Mental deficiency (p 1.3?) *Psychoses* (p 1364) *Behavior problems* (p 1359) Congenital anomalies (p 1407) Birth injuries (p 2772) Meningitis (p 14 2) Encephalitis (p 441) Poliomyelitis (p 457) Convulsions (p 1519) Metabolic disturbances (p 1450)

Digestive Disorders

Congenital anomalies (p 1683) Mechanical and physical disturbances (p 1683) Hypertrophic pyloric stenosis (p 1797) Volvulus (p 1875) Intussusception (p 1876) Meconium ileus (p 18) Stomatitis (p 1697) Pharyngitis (p 2187) Cyclic vomiting (p 2734) *Celiac disease* (p 193) Epidemic diarrhea (p 2756) *Cystic fibrosis of the pancreas* (p 2 8) Parenteral diarrhea (p 2 82) Bacillary dysentery (p 243) Peritonitis (p 1093) *Appendicitis* (p 1881) *Megacolon* (p 18 1) *Hepatomegaly* (p 19 9) Persistence of Meckel's diverticulum (p 1864) Congenital obstruction of bile ducts (p 1994) Prolapse of the rectum (p 1915) Foreign bodies in upper and lower passages (pp 1807 1915)

Respiratory Disorders Including the Ear

Congenital anomalies (p 049) Birth injuries (p 2771) Nasal obstruction (p 2732) Adenoids (p 2139) Myringitis otitis and mastoiditis (p 2143) Tonsillitis (p 2159) Laryngitis and laryngo-tracheitis (p 2159) Bronchitis (p 2168) Pneumonitis (p 2185) Lipoid pneumonitis (p 2048) Lobar pneumonia (p 2171) Empyema thoracis (p ?) Pleural effusion (p 2032) Pulmonary tuberculosis (p 2171) Bronchiectasis (p 2059) *Atelectasis* (p 20 2) *Foreign bodies* (p 046)

Urinary Disorders

Congenital anomalies (p 2281) Urinary obstruction (p 2264) Urinary infection (p 2334) The nephropathies (p 2362) *Enuresis* (p 2265) *Pyelitis* (p 2353) Neoplasms (p 2322)

Disturbances of the Male Reproductive System

Congenital anomalies (p 24 1) Adherent prepuce (p 2422) Meatitis (p 2333) Neoplasms (p 2439)

Disturbances of the Female Reproductive System

Congenital anomalies (p 25 9) Hyperestrogenemia (p 2778) Menstruation in the newborn (p 2778) Vulvovaginitis (p 2586) Lactation and mastitis in the newborn (p 27 8) Neoplasms (p 2547)

Disturbances of the Skeletal and Locomotor Systems

Birth injuries (p 2771) Congenital anomalies (p 2816) Metabolic disturbances (p 850) Hernia (p 3091) The myopathies (p 2884) Carpopedal spasm (p 2778) Disturbances of the growing epiphyses (p 2998) Neoplasms (p 2835)

DIFFERENTIAL DIAGNOSIS OF

Cryptogenic Fevers in Infancy and Childhood

Since the child is subject to the same febrile disturbances as the adult it would be impossible to enter into separate discussion of abnormalities of temperature without reduplicating the material that appears elsewhere (p 26) The Table which follows lists the more frequent causes for fever not revealed by routine physical examination

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Temperature of 100 5 F immediately after birth
Metabolic	Starvation and dehydration particularly associated with acidosis. Examine urine for acetone (p 3680) Scurvy with therapeutic response to cevitamic acid (p 2857) Rickets with therapeutic re ponse to vitamin D and calcium (p 2850)
Traumatic	Particularly birth injuries associated with intracranial bleeding Examine cerebrospinal fluid (p 2772)
Systemic Infection	Bacteremia often associated with omphalitis (p 2785) Gonococcemia with vulvovaginitis or ophthalmia (p 2586) Neonatal syphilis with positive serology (p 2787) Tuberculosis with positive tuberculin reaction (p 252) Meningococcemia with later meningitis as revealed by cerebrospinal fluid (p 208) Rheumatic fever with rapid sedimentation rate and therapeutic response to salicylate (p 186) Pre-eruptive phases of the acute exanthems (p 172) Vaccinia (p 428)
Respiratory Infection	Acute adenoiditis visible only by posterior rhinoscopy (p 2139) Lobar pneumonia or acute pneumonitis demonstrable only by x ray (p 2171)
Digestive Disturbances	Generalized peritonitis following acute appendicitis or in association with streptococcemia penumococcemia or tuberculosis Get smears and cultures by abdominal puncture (p 1823)
Urinary Diseases	Particularly acute pyelonephritis (pyelitis) in the female with pyuria (p 2353) Urinary sepsis secondary to obstructive uropathies due to congenital anomalies (p 2284) Refer to urologist for intravenous and retrograde urograms
Aural Diseases	Acute myringitis or otitis revealed by otoscopy (p 2143)
Neurogenic Disturbances	Intracranial hemorrhage due to birth, trauma (p 2772) Get cerebrospinal fluid (p 3734) Otogenic and rhinogenic meningitis with purulent spinal fluid containing demonstrable pathogen (p 1359) Tuberculous meningitis poliomyelitis or encephalitis with clear spinal fluid but pleocytosis (p 441)

INUED

Neoplasm	Renal hypernephroma with mass in lumbar region and hematuria (p 2322) Bone sarcomas with local swelling and x ray changes (p 2835)
Circulatory Diseases	Subacute bacterial endocarditis engrafted upon congenital cardiac defect. Get blood culture (p 1021)
Blood Diseases	Anemias (p 1055) Leukemias (p 1100) Get hemogram and marrow smear (p 104_)
Skeletal Disorders	*Osteitis and osteomyelitis usually secondary* to trauma or streptococcemia Get blood culture and institute vigorous anti infective treatment

DIFFERENTIAL DIAGNOSIS OF

Jaundice in the Newborn

Jaundice is noted physiologically in the newborn shortly after birth Persistence or deepening of the icterus in association with deterioration in the general condition of the infant, suggests a severe and possibly fatal disturbance

See also Jaundice in the Adult, p 1955

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Results from excessive destruction of red blood cells shortly after birth First noted on the third day of life it should disappear within two or three weeks Not associated *with enlargement of liver or spleen.* Bile pigments absent from urine but present in stool. Blood contains only 1 to 5 per cent erythroblasts
Erythroblastosis Foetalis	Present at birth with progressive increase Liver and spleen enlarged. Bile pigments present in urine and stool Blood spreads reveal in excess of 5 per cent erythroblasts (p 1067) Maternal and paternal bloods show discrepancies in Rh factors (p 1067) Prepare for transfusions of Rh negative blood (p 3778)
Sepsis	Icterus on 3rd to 7th days. Hepatosplenomegaly present. Bile pigments in urine and stool Fever moderate to high Blood cultures positive Institute vigorous anti infective therapy (p 106)
Neonatal Syphilis	Jaundice variable Hepatosplenomegaly usually present. Bile pigments in urine and stool Serology positive (p 2787) Start treatment with penicillin (p 340)
Atresia of Bile Duct	Jaundice appearing from the 1st to 14th day Greenish color Hepatosplenomegaly present Urine contains bile pigments but stool is acholic Condition fatal unless remediable by surgery (p 1944)
Nuclear Icterus (Kernicterus)	Similar to erythroblastosis foetalis (p 1067) but associated with spasticity and convulsive seizures Try transfusions of Rh negative blood (p 3778)

DIFFERENTIAL DIAGNOSIS OF

Decreased Growth

The undersized child is frequently brought to the practitioner by an anxious parent. In most instances physical examination is normal and the cause of the stunting is a mere physiologic lag since growth often is delayed until the time of puberty

In the rare instance in which the practitioner is confronted with the problem of infantilism or dwarfism an extensive survey is required in order to clarify the fundamental difficulty and to obtain specific indications for therapy The term infantilism is here applied to a proportionate diminution in stature whereas dwarfism connotes in addition asymmetry and deformity

CAUSE	DIAGNOSTIC FEATURES
Physiologic Variants	Particularly familial and racial
Primary Hypopituitarism	Retardation of growth without distortion or deformity (Lorain Levi types) Premature senility in the variety described by Simmonds and Hutchinson Gilford. Note therapeutic responses to anterior pituitary growth hormones with estrogen and/or androgen (p 2404)
Secondary Hypopituitarism	Infantilism resulting from profound physical or metabolic disturbances such as congenital heart disease neonatal syphilis diabetes mellitus celiac disease (pancreatic infantilism) severe rickets malnutrition, hookworm infestation, microcephalus, hydrocephalus, idiocy or prematurity (p 2703)
Achondroplasia	Dwarfism with disproportion and retardation of growth of extremities Head enlarged, forehead prominent bridge of nose depressed, abdomen protuberant, buttock prominent, and lumbar lordosis increased.
Dyspituitarism	Obese dwarfism (p 1166) Shortening of arms and legs round face atrophy of genitals and slight depression of BMR (Frohlich's syndrome) Note therapeutic responses to anterior pituitary growth hormones with estrogen and/or androgen (p 2404)
Hypothyroidism	Cretinous dwarfism (p 693) Idiotic facies, mental and sexual retardation, protuberance of abdomen, umbilical herniation, non pitting edema of skin, and marked depression of basal metabolic rate (p 719) Therapeutic response to thyroid extract (p 1183)
Mongolism	Idiocy with small skull flat occiput thick lips open mouth hypermotility of joints and characteristically obliquely set eyes
Rickets	Dwarfism due to dietary deficiency Deformities at epiphyseal junctions. Large square skull with frontal bosses Abnormalities of thoracic cage legs and teeth May have low levels for blood phosphorus Therapeutic response to administration of vitamin D (p. 621)
Renal Rickets	Dwarfism associated with congenital aplasia of kidney or advanced renal damage (p 2240) May be associated with high levels for blood phosphorus. Failure of response to vitamin D

Disturbances of the Tegumentary System

Congenital anomalies (p 3145) Metabolic disturbances (p 3235) Neoplasms (p 3199) Pyodermas (p 3248) The purpuras (p 3423) Omphalitis (p 2 85) Dermatitis medicamentosa (p 3813) Atopic dermatitis (infantile eczema) (p 3312) Scabies (p 3180) Pediculosis (p 318?)

Disturbances of the Eye

Congenital anomalies (p 1560) Birth injuries (p 1 69) Ophthalmia neonatorum (p 1621) Inclusion conjunctivitis (p 1623) Foreign bodies (p 1572) Blepharitis (p 1610) Phlyctenular conjunctivitis (p 1648)

PREMATURITY

About 10 per cent of infants are born prematurely As a group the prematures are highly susceptible to the hazards of environment. About 50 per cent of neonatal deaths occur in premature infants and the majority of these die within twenty four hours after delivery The problem of the premature infant stands as a distinct challenge to obstetricians pediatricians and public health workers since relatively little progress has been made in the reduction of death rates

Criteria of Prematurity —The commonly accepted criteria of prematurity are (*1*) *birth weight* of 5 pounds 8 ounces (2500 gm) or less (*2*) *crown to heel length* of 18 5 inches (47 cm) or less and (*3*) relatively greater disproportion between head and chest circumference than is found at term The span of prematurity is from the twenty eighth week of gestation (period of viability) to the thirty eighth week after which the fetus is considered mature

Standards for determining maturity of the fetus or infant appear useful The fetus is placed in the group in which at least two of three criteria are present (Table 149)

Etiology —The failure of a pregnancy which has passed the period of viability (28th week) to continue to term may result from a great variety of causes Chief among these are diseases affecting the mother such as *hypertensive toxemia of pregnancy intercurrent acute infections chronic infections* especially *syphilis* (p 2787) and constitutional disturbances such as *heart disease diabetes mellitus chronic nephritis* or *essential hypertension*

Multiple pregnancies account for 10 to 15 per cent of premature births and there is a high incidence of prematurity in *hydramnios* (p 2669) In both latter conditions the premature onset of labor is probably related to the overdistention of the uterus *Abnormalities of the placenta* (placenta praevia and premature placental separation) *are common causes of birth* before term Additional factors are maternal overwork undernutrition advanced maternal age emotional upsets trauma and perhaps coitus during the last trimester

The induction of premature labor is a frequent elective procedure and as stated by De Lee there is hardly any condition affecting the pregnant woman that may not give the indication for emptying the uterus A common indication is *fetal-pelvic disproportion* in which it is feared that a full term infant will be unable to traverse a small birth canal In *diabetic pregnancies* (p 2673) premature induction has been especially advised since the full term infant is usually overgrown and too large to

be born safely by the vaginal route Induction is required also in the presence of complications of pregnancy endangering the mother These include *hypertensive toxemia heart failure, chronic nephritis psychoses tuberculosis abruptio placentae* and *placenta praevia*

Clinical Manifestations—The signs of prematurity are fairly characteristic The infant is small with soft delicate semitransparent skin which may be covered with lanugo The nails do not extend to the fingertips and there is little or no subcutaneous fat Cyanosis is frequent the cry is faint and infrequent the body is limp and movements are uncommon and very feeble Lack of muscle strength interferes with sucking and deglutition Body temperature is subnormal

TABLE 149 —CRITERIA OF MATURITY

Abortion

1 Less than 400 gm in weight
2 Less than 28 cm in length
3 Less than 22 weeks (missed abortions included)

Premature

Previable

1 From 400 to 999 gm in weight
2 From 28 cm to 35 cm in length
3 From 22 to 28 weeks

Viable

1 From 1000 to 2499 gm in weight
2 From 35 1 to 47 cm in length
3 From 29 to the end of 37 weeks

Term

1 From 2500 to 4499 gm in weight
2 From 47 1 to 54 cm in length
3 From 38 to 42 weeks

Postmature

1 More than 4500 gm in weight
2 More than 54 cm in length
3 More than 42 weeks

Physiological Handicaps of Prematures—The premature is at a considerable physiologic handicap in many respects The *heat regulating center* is poorly developed excessive amounts of heat are lost by irradiation through the thin and highly vascular skin the ability to sweat is subnormal the respiratory excursion is weak and shallow and as a result body temperature shows extraordinary variations unless preventive steps are taken

The *metabolic needs* of premature infants are difficult to satisfy Caloric requirements high for growth demands are poorly tolerated due to inadequate tolerance and absorption

Prematures have little immunity even to *mild infections* a slight cold or a mild impetigo may lead to general physical decline resulting in death

Pathology.—Premature infants dying shortly after birth reveal many pathologic changes *Cerebral hemorrhages* are common due to the pressure of perineal muscles on the infant's skull and a hemorrhagic tendency The death rate among prematures is higher among those born spontaneously than among those delivered by forceps or cesarean section *Atelectasis* is a frequent finding and is related to the feeble respiratory movements *Apnea* is common especially among prematures whose mothers have received considerable medication during labor morphine is particularly dangerous in this regard

Prognosis.—Prematurity is a *serious threat* to the life of the child General mortality is over 50 per cent and remains high even in the best hospitals The *death rate* varies inversely with the birth weight It is over 90 per cent for infants weighing less than 1000 gm at birth 52 per cent for those between 1000 and 1250 gm 25 per cent for those between 1250 and 1500 gm 25 per cent for those between 1500 and 2000 gm and 12 per cent for infants between 2000 and 2500 gm

The chance of survival in infants weighing more than 1500 gm is about four times greater than in the group weighing less than this amount The *probability of survival* increases with postnatal age Most deaths occur within twenty four hours after birth Less than 10 per cent of prematures succumb after the first week of the neonatal period

Complications.—Should the premature infant survive the immediate hazards of the neonatal period a number of complications occur with considerable regularity unless special precautions are taken Anemia is common due to subnormal storage of iron during the last month of gestation There is increased susceptibility to *rickets* because of large demands for and impaired intestinal absorption of calcium phosphorus and vitamin D *Hypoprothrombinemia* (p 1109) results in a bleeding tendency and *physiological icterus* is apt to be intense

General Principles of Care of Prematures.—In order for a premature to have the best possible chance for survival experienced medical and nursing care and equipment for the control of environmental factors are absolute necessities Immediate objectives are maintenance of body temperature administration of oxygen provisions for adequate nutrition and hydration and prevention of infection

Maintenance of Normal Temperature.—Immediately after birth the body is oiled and wrapped in cotton The child is then folded in blankets and placed in an *individual incubator* with thermostatic temperature control and automatic humidity control Lacking this a *heated bed* with temperature control is used If born at home artificial heat is applied by surrounding the infant in a bassinette or clothes basket with hot water bottles carefully placed to prevent overheating and avoid pressure In the hospital the infant is transported to nursery from delivery room in an incubator or crib provided with special heating equipment

The *ideal ward arrangement* is a warm room in which cribs are separated by glass partitions The nursery temperature is maintained between 80° and 90 F and the humidity at 65 per cent The temperature of the infant is taken at four hour intervals until it is relatively stable Rapid stabilization of temperature is a good prognostic sign As the temperature becomes constant at the normal level artificial heating is gradually abandoned and the infant is clothed in a normal manner Special incubators should be operated only by trained personnel and facilities should be made available for the administration of oxygen

Maintenance of Adequate Nutrition.—The problem of feeding the premature is most exacting. Few premature babies have the strength to suckle so that the use of a rubber-tipped medicine dropper or gavage may be necessary. Formulas of pumped human milk, evaporated cow's milk and preparations of low fat content are most generally used. The present tendency is to stress low fat and high protein and carbohydrate content of a milk formula.

In the first few days of life, tolerance is established by feeding small amounts in low caloric value and increasing them gradually. It is advisable to wait twelve hours after birth before making any effort at alimentation.

During the second twelve hours after birth, 5 per cent glucose in amounts of 8 to 15 cc. are given every three hours. In the following twelve hours, 15 to 30 cc. of a formula of one part of breast milk to one part of 5 per cent glucose are given every three hours. A formula of evaporated milk or a low fat milk (such as alacta) with dextrimaltose containing 20 to 25 calories per kilogram of body weight may be substituted for the breast milk. At the end of 48 hours, 15 to 30 cc. of full strength human milk may be given. Subsequent increase in amounts and caloric intake are made every two days as tolerated, until the infant is receiving 120 to 130 calories per kilogram of weight by the tenth to fourteenth day. This caloric value usually meets the necessary individual requirement and results in satisfactory weight gain. Eight feedings are given daily until the baby weighs 2200 gm., then reduced to seven daily feedings. Six feedings daily should satisfy an infant weighing 2500 gm.

Feeble infants, those requiring 25 to 30 minutes to finish a feeding and those weighing less than 1500 gm., are fed by gavage. During the period of undernutrition it may be necessary to give subcutaneous injections of isotonic saline to maintain hydration.

In addition to the feedings of milk and water, menadione (vitamin K) is injected parenterally in a dose of 2 to 4 mg. immediately after birth and repeated if necessary. Feeble and anemic babies may profitably be given repeated transfusions of 10 to 30 cc. of citrated whole blood.

Before the end of the first week, 25 mg. of ascorbic acid and 5 drops of a vitamin D concentrate are added. The latter is increased until 20 drops daily of percomorph oil or vitamins A and D in oil is given. By the third week of life, iron in the amount of 20 to 25 mg. per kilogram of weight is given by means of a solution of ferric ammonium citrate.

Prevention of Infection.—The premature is handled as little as possible and then only by a trained nurse who is gowned, masked and scrupulously clean. Care is highly individualized and concentration of babies in a nursery is avoided. The importance of aseptic nursing care cannot be too strongly emphasized. The suggestion that lack of estrogenic stimulation may be responsible for some of the physiologic handicaps of prematurity has led to trials of estrogen therapy.

ASPHYXIA NEONATORUM

Some degree of asphyxia is present at birth in every normal infant. Unfortunately, severe anoxemia, leading to widespread physiologic and

pathologic changes is frequent and is one of the most common causes for neonatal death The infant may be born alive as evidenced by the presence of a heart beat but breathing fails to occur or is too feeble to maintain adequate oxygenation of the blood The inevitable result is fatal asphyxia which was found to be the chief cause of death in 58 per cent of infant autopsies at the Boston Lying In Hospital since 1931

Physiology —The mechanism of internal respiration is established long before birth and irregular respiratory movements occur during the latter third of intra uterine life The essential difference between intra uterine and extra uterine respiration is that gaseous exchange in the former takes place through the placenta and in the latter through lungs

The normal baby should take its *initial gasp* within two seconds and should cry within five seconds *Normal respiration* is established within ten seconds after the head is born A delay for as long as thirty seconds is abnormal and indicates the danger of asphyxia

Etiology —Asphyxia at birth may be of *central* or *peripheral origin*

Peripheral Asphyxia —Asphyxia of peripheral origin results from some interference with the process of diffusion of oxygen into the circulation This occurs in utero from *premature separation of the placenta* or *twisting of the umbilical cord* or from *anemia* or *asphyxia* of the mother After delivery it is due to *obstruction of the airway* by mucus blood amniotic fluid or meconium *atelectasis pneumothorax* or *congenital defects* of the thoracic cage or muscles of respiration

Central Asphyxia —The majority of instances of asphyxia result from interference with the infant respiratory center This may be due to direct *cerebral trauma* the action of *toxins* circulatory disorders such as shock or uterine apoplexy or the excessive use of *sedatives analgesics* and *anesthetics* aimed at the accomplishment of *painless childbirth* (p 2678)

The incidence of asphyxia varies directly with the depth of *obstetrical analgesia Barbiturates* and *opiates* depress medullary centers *scopolamine* and *paraldehyde* prolong labor and exert a direct toxic action on the brain cells prolonged *inhalation anesthesia* with less than 20 per cent oxygen in the gaseous mixture is a chief offender When *general anesthesia* was used in cesarean section 3 5 per cent of babies were stillborn 23 per cent were severely asphyxiated and only 58 per cent breathed immediately When *spinal anesthesia* was used there were no stillbirths only 4 per cent were severely asphyxiated and 92 per cent breathed at once and these results are exceeded with caudal analgesia

The production of asphyxia is favored by many factors acting singly and in combination The incidence of asphyxia is more than twice as great in mothers suffering from *toxemia* and other *complications* of pregnancy It is more frequent in *primiparas* and increases in incidence with the mother s age *Fetal-pelvic disproportion* and prolonged labor are major factors in causation

Severe asphyxia is more than twice as common in prematures as in full term infants The danger of asphyxia decreases the nearer the child approaches term This is due in all likelihood to better development of the respiratory center and its lessened susceptibility to trauma and drugs

The incidence of asphyxia is increased by all factors that increase trauma These include *prolonged labor* and *forceps delivery* Operative

obstetrics is attended by a higher incidence of asphyxia than spontaneous births due to deep anesthesia direct cerebral injury and shock

Pathology—The pathological changes in asphyxiated infants are widespread and include congestion edema hemorrhage and tissue degeneration The brain meninges lungs and abdominal viscera are congested and show multiple punctate and diffuse *hemorrhages* The heart is dilated The liver reveals fatty infiltration and tissue necrosis The lungs may contain no air or may be expanded and even emphysematous The respiratory passages may be filled with mucus meconium or amniotic fluid Central nervous tissues show ganglion cell degeneration and encephalomalacia In apneic infants the oxygen saturation of the blood is low (5 to 10 per cent) while the concentrations of carbon dioxide and lactic acid are high

Clinical Manifestations—*Before birth* sudden or gradual slowing of the fetal heart indicates intra uterine asphyxia of the infant The fetus becomes more active convulsive activity may be detected, and meconium appears in the amniotic fluid

At birth the appearance of the child varies with the degree of asphyxiation In mild cases the striking feature is intense *cyanosis* the skin being dark bluish red (*asphyxia livida*) Respiratory excursions are feeble infrequent or absent Stimulation of the skin produces reflex inspiratory efforts The pulse is strong and of good quality The heart rate is usually slow and muscle tone is good

Asphyxia of mild degree is quickly terminated by appropriate therapeutic measures Within a short period respirations became frequent and deeper there is a restoration of normal color and the onset of loud crying A few infants however fail to respond and become more deeply asphyxiated

In severe asphyxia the picture is that of profound generalized depression The skin is pale (*asphyxia pallida*) and the pulse is barely palpable The heart rate is excessively slow or fast and sounds are of poor quality Muscle tone is abolished so that the body is limp The sphincters are relaxed and meconium oozes from the anal orifice Respiratory movements are weak and short lived and may be entirely absent even after reflex stimulation of skin and pharynx

Course and Complications—More than 86 per cent of infants with severe asphyxia respond to proper treatment In many cases, however the ultimate prognosis is poor since *cerebral hemorrhage* is common and long continued severe asphyxia leads to irreparable damage to the central nervous system Severe asphyxia at birth may be followed by *spastic diplegia cerebral atrophy epilepsy* and *mental deficiency* The incidence of asphyxia at birth is significantly high in backward school children Prematures are especially liable to severe asphyxia

In addition to remote complications the newborn frequently manifests additional disturbances of the respiratory system These include atelectasis pneumothorax and pneumonia

Treatment—The problem of asphyxia neonatorum is approached by preventive and active therapeutic measures

Prophylaxis—The prophylaxis of asphyxia neonatorum consists in attempts to eliminate or lessen etiologic factors Minimal trauma is inflicted to the child s cranium during passage through the birth canal The mother must be given to understand that the price of *painless childbirth* may be creation of a state of anoxia in her child at birth Efforts are made to

reduce the amount of barbiturate to a minimum and *morphine* and its derivatives and substitutes are avoided during the last four hours of labor The introduction of *caudal anesthesia* (p 2680) promises to minimize maternal pain without endangering the welfare of the child

Active Treatment—If *apnea* is present at birth the first step is to clear mouth pharynx and trachea of mucus by *suction* through a *tracheal catheter* The head is lowered to assist in expulsion of material from lungs Prompt *tracheal aspiration* is of major importance no time is wasted waiting to see if the child will breathe spontaneously The child should not be slapped and the chest should not be compressed These maneuvers are of little value and their performance may injure the child and delay important procedures of greater benefit

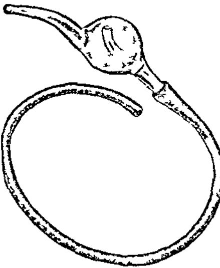


Fig 697—Tracheal catheter This is a woven catheter open at the end size 11 or 1 French scale For premature infants, size 10 or 11 is used These catheters may not be boiled but are sterilized chemically or in formaldehyde vapor The glass end piece will catch the operator's saliva and also serve to arrest mucus, etc which he might otherwise draw into his mouth The new U S catheters may be boiled but are harder and require more care in passing them

In passing a *tracheal catheter* the finger feels for the infant s epiglottis and the arytenoid cartilages The epiglottis is swung forward and the catheter is gently guided into the trachea An alternate method is to pass the catheter under *direct laryngoscopy* The passage of the catheter is often an effective reflex stimulus to respiration *Suction* is applied to remove mucus and fluid With air passages free improvement may be immediate During the above and any subsequent procedures the infant is wrapped in warm towels to prevent heat loss

With the tracheal catheter in place the infant s lungs are oxygenated by *direct mouth to lung insufflation* The operator fills his lungs with fresh air and applies his lips to the mouthpiece Only the amount of air that can

be held in the mouth is introduced and care is exercised not to exceed a pressure of 12 mm of mercury Catheters are available that prevent the development of excessive pressures Gentle compression of the chest after inflation allows the air to escape The procedures of *insufflation* and *compression* are repeated fifteen times a minute In severe asphyxia, it is best to administer a high concentration of oxygen (80 to 100 per cent) by means of an *inhalator* or *resuscitator*

Various mechanical appliances such as the *lung motor pulmotor* and *Drinker respirator* have been devised for use in the treatment of asphyxia When used properly and promptly, they are of great value and may prove superior to tracheal catheterization and mouth to-lung insufflation

Analeptic drugs such as *alpha lobeline coramine* and *camphor* are of questionable value as respiratory stimulants and may be dangerous in apneic infants These drugs cannot stimulate an anoxic depressed respiratory center and may further exhaust the center in the absence of sufficient oxygen Once respiration is established and anoxia has abated an analeptic may hasten full recovery from respiratory depression in infants whose mothers have been heavily sedated during labor External stimulation of the skin pinching spanking alternate hot and cold baths and compression of the chest are of dubious value and may even accentuate *cerebral hemorrhage*

After delivery newborn infants are closely observed for at least twenty four hours for the sudden *arrest of respiration* This may occur in infants apparently normal at birth as well as in asphyxia neonatorum In the event of sudden stoppage of breathing resuscitative measures are instituted without delay

CONGENITAL ATELECTASIS

With the establishment of normal respiration at birth expansion of the lungs takes place readily and is usually complete within two or three days The first parts to be inflated are the anterior borders of the lungs then upper lobes and finally lower lobes Inflation is irregular due to mucus in the bronchial tree

Atelectasis is favored by the causes of asphyxia neonatorum (p 2767) When there is no history of asphyxia at birth atelectasis is apparently the result of feeble respirations and possibly a fatigued respiratory center Cohesion of the moist surfaces of the air passages in collapsed airless lungs offers mechanical resistance to the entrance of air When this normal resistance is coupled with an injured respiratory center an imperfectly developed thorax or diaphragm and bronchial obstruction by mucus blood or amniotic fluid the state of atelectasis becomes prolonged to a pathologic extent

Pathology—At autopsy only the superficial parts of atelectatic lungs are inflated while the central portions of the lobes are unexpanded Small subpleural hemorrhages are frequent Evidences of pneumonia are invariably present if the infant has survived for several days There is usually marked congestion of abdominal viscera and dilatation of the right heart

Clinical Manifestations—It is probable that the infant may have quite considerable areas of atelectasis without manifest clinical evidences How

ever those children in whom asphyxia is encountered at birth with only partially successful resuscitation are prone to have repeated attacks of *cyanosis* attended by shallow irregular respirations Though these are more common in small delicate infants they may occur in apparently nor mal vigorous children Death may occur during an attack

Physical signs are of little localizing value except when involvement is unilateral The radiographic picture proves helpful when there is irregular consolidation of one side with contrasting increased radiability of the un involved lung

Treatment —Inflation of the lungs is favored by stimulating the new born infant to *cry* loudly each day A certain amount of *exercise* is encour aged by lifting the child frequently massaging the chest and changing position in the bed Abdominal distention is avoided since elevation of the diaphragm prevents adequate aeration of the lower lobes

If it is known that there are significant areas of atelectasis inhalations of a combination of *oxygen* and *carbon dioxide* are of considerable value (p 3827)

PNEUMOTHORAX

Pneumothorax of the newborn infant results most often from over zealous insufflation in the treatment of *asphyxia neonatorum* (p 2769) The condition is difficult of recognition unless the chest obviously bulges syn chronously with an increase in *dyspnea* and *cyanosis*

In rare instances spontaneous pneumothorax occurs from rupture of a *congenital pulmonary cyst* (p 2044) The physical signs are difficult to elicit (p 2035) unless there is an obvious subcutaneous emphysema If pneumothorax is recognized the development of positive intrathoracic ten sion is prevented by inserting a needle into the involved pleural cavity and providing for underwater drainage

PNEUMONIA

While pneumonia is listed as a common cause for death in the newborn it is rare as a primary condition and usually occurs with *asphyxia atelec tasis* or *pneumothorax* *Syphilitic stillbirths* (p 2671) manifest an extensive pneumonic process the so called *pneumonia alba* The pulmonary infec tion also may be secondary to *sepsis aspiration* or *insufflation*

Pneumonia of the newborn is rarely recognized until autopsy The child shows evidences of the general infection with or without fever tachy cardia failure to gain weight and recurrent or persistent cyanosis Even with intensive therapy using *oxygen* in high concentration in a Burgess box and adequate doses of *sulfonamides* and *penicillin* recovery is hindered by continued operation of the primary causative factors and impaired re sistance of the child

BIRTH TRAUMA

Birth injuries are among the commonest causes of death and morbidity during the neonatal period Most lesions involve vascular nervous or os seous structures

CEPHALHEMATOMA

Subperiosteal collections of blood are the result of increased pressure on the skull bones during labor The hematoma is usually external and is seen as a soft fluctuant swelling beneath the scalp although it may lie between skull and dura mater Predisposing causes include prolonged vertex presentation and asphyxia The condition is somewhat more common in infants of primiparas in those born during a dry labor and in prematures

Clinical Manifestations —The location of the cephalhematoma bears a close relation to the position of the head in the pelvis In most instances it is found over the *right parietal bone* due to the frequency of left occiput anterior presentation



Fig 698 —Double cephalhematoma This followed a spontaneous and relatively easy delivery *

The swelling generally becomes apparent two or three days after birth and increases in size for about a week It is tense fluctuant *and does not* pulsate After a few days a bony ridge is felt around the periphery Absorption of the hematoma is complete in two or three months but the bony ridge may remain for almost a year Occasionally a cephalhematoma becomes infected with the formation of a large abscess

Diagnosis —The cephalhematoma must be differentiated from the *caput succedaneum* an edematous swelling of that portion of the scalp which presented through the dilated cervix The caput disappears in a few days and has no marginal wall *Meningoceles* and *encephaloceles* (p 1411) pul

* DeLee and Greenhill, Principles and Practice of Obstetrics 8th Ed

sate on crying and respiration and are often reducible An *angioma* increases in size on crying and lacks fluctuation and the bony wall

Treatment —The cephalhematoma is protected by placing the infant s head so that the hematoma cannot be further traumatized If suppuration develops the area is incised and drained

INTRACRANIAL HEMORRHAGES

Intracranial hemorrhages are found at autopsy in over 30 per cent of infants born dead or dying during the first two weeks of life The principal *cause is trauma* The latter is favored by excessive molding of the head in prolonged labors by breech deliveries and the use of forceps It is common in prematures and is seen occasionally in normal easy labor and in babies delivered by elective cesarean section *Asphyxia neonatorum* (p 2766) and *hemorrhagic disease of the newborn* (p 1111) are contributory causes

Pathology.—The hemorrhages are predominantly venous in origin and are usually located to the surface of cortex and meninges although they occur in cerebral tissue and ventricles Rupture of the tentorium from excessive molding is frequent and fractures of the base of the skull and the calvarium are not uncommon The source of the bleeding may be the small vessels coursing along the tentorium the great vein of Galen which joins the straight sinus in the tentorium the superior longitudinal sinus the transverse and straight sinuses or the internal cerebral veins The first two sites are the most common and the remainder are relatively rare

Clinical Manifestations —The clinical picture is determined by the degree of trauma and the extent of the bleeding The child is usually *stillborn* In less severe instances it is deeply *asphyxiated* and difficult to resuscitate Shortly after birth the effects of cerberal injury become apparent through recurrent *cyanosis failure to nurse feeble cry bulging fontanelles nuchal rigidity convulsions nystagmus ocular palsies exophthalmos retinal hemorrhages* and changes in the tonus or reflexes of the extremities

Diagnosis —The presence of an intracranial hemorrhage is suggested by the characteristic behavior of the child and the presence of fairly typical physical findings *Spinal puncture* may show *bloody or xanthochromic fluid* (p 3734) beyond what is normally present The presence of crenated erythrocytes is especially suggestive

Prognosis —Infants with large basilar hemorrhages rarely live for more than a few days The survivors invariably show some late sequel such as *spastic hemiplegia mental deficiency bilateral spastic paralysis athetoses dystonias hydrocephalus* or *epilepsy* The prognosis should be guarded *since defects are often not evident until later in life*

Treatment —Treatment is mainly prophylactic and includes measures to reduce the duration of labor the depth of anesthesia and the incidence of prematurity *The administration of vitamin K* to the mother before labor and to the infant at birth is desirable in view of the physiological coagulation defect present at birth in most infants

Active measures include the *treatment of asphyxia* (p 2766) and *shock* (p 928) The infant is kept warm and handled as little as possible Fluids are given orally by means of a medicine dropper and the head of the bed is elevated

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Cranium in Infancy

Disturbances of the head are frequently observed in infancy They are mostly due to trauma which occurs during passage through the birth canal, also they may result from congenital anomalies metabolic derangements and glandular dystrophies Symptoms referable to the fontanelles are separately discussed (p 2729)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Macrocephalus	
Hydrocephalus	Water or pumpkin head with bulging of fontanelles and increase in intracranial fluid. May be obstructive or nonobstructive as revealed by ventricular (p 3783) and spinal (p 3781) punctures Refer to neurosurgeon
Rickets	Vitamin D deficiency with frontal bosses, craniotabes and head sweating Therapeutic response to correction of metabolic defect
Achondroplasia	With dwarfism and relative increase in size of head as compared with body
Microcephalus	
Pituitary infantilism	Levi Lorain dwarfism without deformity (p 693)
Amaurotic family idiocy	With blindness mental deterioration and cherry red spots of fundus (p 1333)
Abnormalities of the shape of the head	
Oxycephalus	Tower skull
Scaphocephalus	Narrow elongated head. May be associated with optic atrophy anosmia and mental deficiency (p 1332)
Dolichocephalus	Bulbous elongated head. May be associated with optic atrophy anosmia and mental deficiency (p 1332)
Mongolism	Small head with obliquely set eyes usually associated with mental deficiency (p 1332)
Craniotabes	
Rickets	See under Macrocephalus above
Neonatal syphilis	With positive serologic changes in maternal, umbilical or fetal blood (p 2787) Specific response to therapy (p 340)
Isolated swellings and tumors	
Cephalhematoma	Appears on 2nd or 3rd day in temporal or parietal region Disappears in 7 to 14 days
Caput succedaneum	Appears at birth in occipital or parietal regions Disappears in 2 or 3 days
Herniation of intracranial contents	In median line with increased size on crying May contain brain (cephalocele) meninges (meningocele) or fluid (hydroencephalocele) All manifest at birth Refer to neurosurgeon
Benign neoplasms	Usually dermoids (p 1566) near orbit, glabellum or external angular region of frontal bone Sebaceous cysts usually in lateral areas.
Neonatal syphilis	With frontal bosses and craniotabes (p 2787)

CONTINUED

Prominence of veins

Rickets	See above
Neonatal syphilis	See above
Internal hydrocephalus	See above

SUBDURAL HEMORRHAGE AND HEMATOMA

Subdural hemorrhage results from extravasation of blood from subdural venous communications over the cerebral convexities In time encapsulation occurs

In the neonatal period symptoms may consist of lethargy or hyperirritability irregular respirations vomiting and convulsions Symptoms referable to the central nervous system may appear only after several months and manifest themselves as stupor irritability paralyses hypertonicity convulsions bulging fontanelles enlarging head and papilledema *Frequently the only presenting symptom is delayed development and general* failure to do well The condition is often unsuspected when vague uncharacteristic symptoms appear which cannot be explained

The diagnosis is made when tapping the subdural space through the anterior fontanelle discloses an increased amount of cerebrospinal fluid with increased protein xanthochromia or actual blood In older infants burr openings are necessary There may or may not be associated increase in cerebrospinal fluid pressure and elevation of fluid protein

Treatment consists in the administration of menadione and repeated subdural tappings Drainage through burr openings and radical excision of the encapsulating membrane may be necessary in older infants The prognosis is fairly good if the condition is recognized early and treated adequately

HEMATOMA OF THE STERNOCLEIDOMASTOID MUSCLE

Hemorrhage into the belly of the sternocleidomastoid muscle results from rupture of its muscle fibers and blood vessels in breech deliveries and forcep extractions Occasionally it occurs in the absence of apparent trauma

The hemorrhage is usually *unilateral* and is more common on the *right side* although it may be *bilateral* The hematoma is an oval mass about an inch in length It is movable beneath the skin hard and tender It usually appears during the second postnatal week The head may or may not be drawn to the affected side and the chin is turned contralaterally The prognosis is good as the swelling disappears in two or three months Occasionally a slight *torticollis* (p 2816) remains but this is rarely a permanent deformity

No treatment is necessary

VISCERAL HEMORRHAGES

With the exception of intracranial hemorrhages visceral bleeding is rare Occasionally intra abdominal bleeding is precipitated by birth trauma or during resuscitation of asphyxiated infants Rarely pulmonary hemorrhages are produced The clinical features are vague and often escape notice until collapse or death of the child

DIFFERENTIAL DIAGNOSIS OF

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CONTINUED

regained In chronic afflictions facial muscles are kept in tone by physio therapy

SPINAL CORD INJURIES

One of the principal dangers of a *breech delivery* is the fact that the spinal cord may be torn as a result of elongation of the vertebral column due to traction This is especially apt to occur when there is difficulty in delivering the after coming head The cord usually tears in the upper thoracic region There is extensive hemorrhage which may exert pressure on the medulla and phrenic nerve nuclei resulting in death or difficulty in resuscitation If the child lives there is a complete paralysis of the mus culature of the trunk and lower extremities and a loss of sensation in these areas

The prognosis is poor in view of the susceptibility of these infants to infection Some children live for many years and very rarely sufficient spontaneous improvement occurs to enable the youngster to control blad der and rectum and to walk

Treatment —There is no treatment other than general care to prevent infection

INTRA UTERINE FRACTURES

Fractures of fetal bones may occur in utero The commonest cause is *osteogenesis imperfecta* (p 2798) a congenital disorder of bone formation Fractures are usually multiple involving long bones and ribs Union occurs slowly with little callus formation

Rarely an intra uterine fracture may be the result of trauma to the maternal abdomen This is more likely as a result of *oligohydramnios* (p 2668) when the child is unprotected by the amniotic fluid

FRACTURES DURING DELIVERY

The trauma of delivery produces fractures in infants with osteogenesis imperfecta (p 2798) and in normal infants born of difficult labors *Skull fractures* (p 1450) are perhaps the most common and other bones fre quently affected are *clavicle humerus* and *femur*

Fractures of the *clavicle* frequently occur in the middle third as a result of efforts to bring down an arm in a breech delivery or to free a shoulder in an obstinate head presentation Swelling angulation and ten derness are noted in the affected area The *humerus* is usually broken at junction of middle and lower thirds of shaft Displacement of fragments is unusual The *femur* is one of the most frequently fractured bones during delivery The break usually occurs in the middle third and produces marked anterior angulation at the fracture site

Fractures in the newborn require only the gentlest manipulation for *reduction* A soft cotton bandage is sufficient for immobilization unless there is marked displacement of the fragments or a tendency to slipping Under the latter circumstances the services of the consultant surgeon are best employed to prevent serious later deformity and disability

PHENOMENA DUE TO STIMULATION OF FETAL ORGANS BY MATERNAL HORMONES

A number of interesting clinical phenomena are encountered in the newborn as a result of stimulation of the fetus by maternal pregnancy

BRACHIAL PLEXUS INJURIES

Injuries of the nerves of the brachial plexus are responsible for the *obstetrical paralyses* of the upper extremity in newborn infants An injury of this type is most common after a difficult labor requiring operative interference The trauma is usually produced by manipulations that draw the head and neck away from the shoulder, thus exerting traction on the brachial plexus Depending on the degree of tension the nerves may be temporarily injured or extensively torn Nerves may also be injured by compression by the blades of forceps

Erb s Paralysis—The common form of paralysis is the *upper arm type* (Erb) due to injury of the fifth and sixth motor roots The paralyzed muscles are biceps brachialis anticus, supinators and supra and infra spinatus The arm hangs at the side rotated inward with forearm pronated The biceps reflex is lost and there may be anesthesia of the outer surface of the arm The triceps and muscles of the forearm and hand are unaffected Atrophy of the paralyzed muscles occurs quickly but it may not become grossly apparent until the end of the second year The paralysis may be complicated by fractures of the clavicle neck of the scapula or humeral shaft

Klumpke s Paralysis—Injury to the lower roots of the brachial plexus produces the *lower arm type* of paralysis (Klumpke) This is a rare condition which involves the seventh and eight cervical and first thoracic roots It results in loss of function of the intrinsic muscles of the hand and may injure the sympathetic ganglion producing *Horner s syndrome* of miosis enophthalmos and pseudoptosis

In about one quarter of the brachial plexus injuries there is a combination of the *upper and lower arm types* of injury

Treatment—Prophylaxis is of greatest importance in nerve injuries The head must not be lifted too sharply up or down during the delivery of the shoulders in normal labor In breech deliveries excessive stretching of the neck is avoided As soon as paralysis is discovered contractures are prevented by carefully planned splints and supervised physiotherapy If at the end of six months or a year there is considerable residual paralysis surgical exploration is attempted to repair torn roots Contractures and bony deformities are corrected by appropriate orthopedic procedures

FACIAL NERVE INJURY

Facial nerve injuries during labor are usually produced by the pressure of a *forceps blade* upon the nerve trunk as it leaves the stylomastoid foramen or as it crosses the ramus of the mandible The injury may also follow pressure of the promontory of the sacrum and the ischium when the head is arrested at one of these points A peripheral palsy affecting one half of the face is the usual result The paralysis may be apparent after delivery but is usually noticed on the second day Failure of closure of the eye on the affected side is often the first noticeable sign In crying the whole side of the face fails to participate in the contortion

The paralysis usually disappears within a few hours or days In severe injuries it may remain for more than three months

Treatment—The eye is protected until the power of the orbicularis is

per 100 cc inorganic phosphorus is normal or high and calcium is absent from the urine The condition is usually temporary and responds satis factorily to treatment Occasionally refractory and fatal cases are en countered The cause of tetany neonatorum is unknown It is logical to regard it as a physiological *hypoparathyroidism* which is related to in crease in maternal parathyroid function in the last trimester

DIFFERENTIAL DIAGNOSIS OF

Increased Growth

Anxious parents not infrequently bring children for consultation as the result of abnormally rapid growth Many young ters attain adult size as early as the twelfth year Increased stat ure is rarely accompanied by a proportionate gain in weight, so that the child appears awkward, frail and lean, and may have deep circles under the eyes It is common belief amongst the laity that excessive growth is unhealthy and may result in diminished resistance particularly weakening of the heart De pite these fears examination reveals no signif icant abnormality and the hemogram is surprisingly normal The child rarely suffers from any disturbance beyond expected disabilities of puberty and adolescence The practitioner confidently may assure the parents that increased tature is a physiologic variant since pathologic alterations in he ght are sufficiently rare to be counted as medical curiosities As urance may also be given that there is no justification for fearing heart strain Normal exercise may be encouraged and there is no need for gland treatments which have much greater potential for harm than for benefit

CAUSE	DIAGNOSTIC FEATURES
Physiologic Variants	Usually familial or racial
Prepuberal Hyperpituitarism	In gigantism (p 1155) growth stimulus occurs before epiphyses have joined May be asso ciated with eunuchoid or acromegaloid fea tures and disturbances of vision Get x ray of sella turcica (p 1152)
Postpuberal Hyperpituitarism	Acromegaly (p 1177) in which growth tim ulu occurs after junction of epiphyses Marked change in the short and flat bones with prognathous enlargement of feet and hands and genital disturbances Note en largement or destruction of sella turcica (p 1177) Contraction and defects in visual f elds (p 1158) with expanding pituitary tumors (p 1175)
Hyperpinealism	Macrogenitosomia praecox (p 1185) with ma ked sexual hyperdevelopment

Tetany neonatorum is treated by oral or intramuscular administration of calcium gluconate Vitamin D is withheld until the blood calcium level has been raised

HYPOGLYCEMIA OF THE NEWBORN

Hypoglycemic convulsions may be encountered in infants born of dia betic mothers (p 2673) The seizures have been ascribed to a temporary state of *hyperinsulinism* from the enlargement and increased function of the islands of Langerhans Treatment requires the intravenous injection of dextrose

hormones The anomalies include lactation, mastitis genital stimulation, vaginal bleeding growth changes infantile tetany and hypoglycemia

LACTATION OF NEWBORN ("WITCH'S MILK")

Swelling of the breasts of newborn infants is often noticeable on the second day after birth It increases in amount for eight to ten days and then subsides gradually with complete disappearance in three or four weeks Pressure on the swollen mammary gland elicits a secretion of *witch's milk* similar in chemical composition to colostrum It is seen with equal frequency in both sexes On histological examination the mammary glands show proliferative changes in alveoli and ducts resembling those of the mother The excretion of milk after birth is related to the cessation of the hormonal influence of the placenta

MASTITIS OF THE NEWBORN

Acute infection of the lactating breast of the infant is not infrequent Usually it is due to slight trauma and manipulation It is most common during the *second* and *third* weeks and is marked by the classical clinical signs of inflammation An abscess usually forms and a diffuse phlegmon may end fatally Spontaneous resolution often occurs and rupture of an abscess is common Subsequent scarring may interfere with the normal development of the female breast

Treatment—Mild infections respond to cleanliness and hot wet dressings In severe infections the abscess is *incised* and *drained* *Sulfonamides* and *penicillin* aid resolution and hasten healing The condition is prevented by protecting the infant's breasts with clean cotton pads when lactation is profuse

GENITAL HORMONAL STIMULATION OF NEWBORN

The reproductive organs of the newborn show evidences of hormonal stimulation at birth The *uterus* and *vulva* are slightly enlarged but decrease in size during subsequent weeks Similar changes are noted in the *seminal vesicles* and *prostate glands* due to gonadal stimulation by placental gonadotropic hormones and maternal estrogen

In female infants the endometrium is hypertrophic and vascular and may give rise to a small amount of *vaginal bleeding* Blood stained mucus and small clots may be found on the labia The bleeding usually lasts only one or two days but may persist for a week It requires no treatment and should cause no alarm

GIANTISM

Maternal endocrine abnormalities present during pregnancy affect the growth and development of the fetus *Giant stillborn infants* are not infrequent in *diabetic pregnancies* (p 2673) The overgrowth of the fetus has been attributed to excessive stimulation with anterior pituitary hormone

TETANY OF THE NEWBORN

Tetany is occasionally seen in newborn infants Clinically the syndrome is similar to that in older infants and is characterized by signs of *increased neuromuscular irritability* The blood calcium is below 7.5 mg

per 100 cc inorganic phosphorus is normal or high and calcium is absent from the urine The condition is usually temporary and responds satisfactorily to treatment Occasionally refractory and fatal cases are encountered The cause of tetany neonatorum is unknown It is logical to regard it as a physiological *hypoparathyroidism* which is related to increase in maternal parathyroid function in the last trimester

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DIFFERENTIAL DIAGNOSIS OF

Convulsions in Infancy

Convulsions are more often encountered in infancy and in childhood than in adult life The hypersensitive nervous system may respond violently to many and diverse irritants Repetition of the incident requires careful investigation which usually reveals only a few basic causes (W C Davison) Between the ages of infancy and 15 years the following disturbances were noted epilepsy 33% acute infection 23% cerebral hemorrhage 15% tetany 14% miscellaneous 9% unknown 6%

See also Convulsions in Adult p 1519

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Traumatic	Following head injury and cerebral hemorrhage during birth Particularly after prolonged or forceps delivery Get cerebrospinal fluid (p 3734) Consult with neurosurgeon
Pharmacodynamic	Following overzealous use of alleged respiratory stimulants such as camphor caffeine strychnine coramine and metrazol used in asphyxia neonatorum (p 2766)
Metabolic	Hypoglycemia in newborn of diabetic mothers With carpopedal spasm in tetany due to physiologic hypoparathyroidism (p 2778) In association with rickets Note therapeutic response to vitamin D and calcium (p 620) With acidosis and ketone bodies in urine
Infectious	At onset of any acute infection With hyperpyrexia from whatever cause Meningitides and encephalitides (p 1432) Positive findings in cerebrospinal fluid (p 3735) Cerebrospinal syphilis with positive findings in blood and spinal fluid (p 2787) Pertussis after paroxysmal cough (p 278)
Neurogenic	Epilepsy with therapeutic response to dilantin (p 1515) Get electroencephalogram (p 1404) Particularly with congenital anomalies such as hydrocephalus porencephaly cerebral dysfunction subdural hematoma tuberous sclerosis Supplement neurologic examination with observation of fundi and analyses of cerebrospinal fluid (p 3734) Consult neurosurgeon
Blood Disturbances	Erythroblastosis foetalis and nuclear icterus (p 1067) Note characteristic hemogram and Rh discrepancy in maternal and paternal bloods (p 1067) Reticulo-endothelioses with cutaneous xanthomas cranial nerve palsy splenomegaly and characteristic cells in marrow spreads (p 1133)
Endocrinopathies	With status thymicolymphaticus (p 1236) Get x ray of chest and consider roentgen therapy

NONSPECIFIC OR SYMPTOMATIC TREATMENT OF CONVULSIONS IN INFANCY

The nonspecific treatment of infantile convulsions includes both negative and positive contributions The former consist of allaying the panic state of the mother and other spectators and the prevention of the institution of harmful emergency measures such as forced feedings of whisky and brandy injections of caffeine camphor digitalis and alleged respiratory stimulants and administrations of paregoric bromides and ammonia In place of hysteria and polypharmacy the practitioner should attempt to clear the room of relatives and friends substitute skillful neglect for purposeless activity and rely on a single sedative carefully administered in full dosage

1 Place the child in a warm bath and hold it there until relaxation occurs
2 If this maneuver is unsuccessful consider inhalation anesthesia with ether ethyl chloride or chloroform or intravenous anesthesia with sodium pentothal using 2 or 3 cc of a 5 per cent solution by very slow injection
3 For repeated convulsions after the bath or anesthesia prepare for lumbar puncture (p 3781) under anesthesia if necessary
4 Finally all else failing give 60 to 200 cc of 50 per cent magnesium sulfate by mouth or by rectum

PARENTERAL DIARRHEA

Parenteral diarrhea is not a disease entity but a symptom which accompanies acute infections other than those of the intestinal tract It may be accompanied by vomiting

Parenteral diarrhea is most frequent in the first two years of life in infants with severe upper respiratory infections especially those with otitis media and unsuspected infections of the urinary tract The severity varies with the age of the infant and the intensity of original acute infection

The condition is treated by adequate control of the original infection temporary starvation and a gradual return to full caloric intake In severe cases parenteral injections of fluid may be required to correct dehydration and acidosis and to restore the acid base balance The prognosis is generally good but varies with the severity of the underlying infection the adequacy of treatment and the age of the patient Breast fed infants generally fare better than those artificially fed

SYMPTOMATIC TREATMENT OF INFANTILE DIARRHEA

The generic treatment of infantile diarrhea may be summarized as follows

1 Maintain water and electrolyte balance by oral use of boiled water physiological saline solution sweetened with saccharin bouillon (each cube contains 2 4 gm of salt) 5 per cent dextrose or barley water
2 If balance cannot be maintained with oral feedings give subcutaneous intraperitoneal or intravenous saline saline with 5 per cent dextrose Hartmann s molar lactate or Ringer s solution Do not

exceed 150 cc per kg of body weight per day (60 cc per lb per day)

3 Add plasma or blood to intravenous drip, if indicated Do not exceed a total of 100 to 200 cc per day

DIFFERENTIAL DIAGNOSIS OF

Diarrheas in Infancy

Diarrhea in infancy constitutes a serious threat The child rapidly becomes dehydrated. As a result profound tissue changes may occur from which recovery is never absolutely complete

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Epidemic Diarrhea	Of newborn in nur eries Severe toxemia No definite pathogens isolated from stool Try combined treatment with penicillin and sulfaguanidine (p 88)
Acute Alimentary Toxicosis	Of newborn With hepatomegaly Use supportive therapy with saline plasma and blood by vein (p 3775) Try penicillin (p 106)
Cystic Fibrosis of the Pancreas	Copious fatty stools with pancreatic enzyme not demonstrable in duodenal content. Eventual malnutrition Note therapeutic response to high protein diet and pancreatic extract (p 2785)
Celiac Syndrome (Sprue)	Copious fatty stools with pancreatic enzyme demonstrable in duodenal content and in feces Marked malnutrition Therapeutic response to high protein diet and pancreatic extract (p 1937)
Parenteral Diarrhea	Symptomatic response in severe infections especially those involving respiratory and urinary tracts Replace fluid loss with parenteral therapy if necessary (p 2781)
Bacillary Dysentery	With isolation of pathogen from stool (p 243) Note therapeutic response to oluble and in soluble sulfonamide (p 88)
Amebic Dysentery	Isolation of amebae from stool (p 523) Note therapeutic response to emetine (p 527)
Omphalitis	Irritative diarrhea with associated septicemia Institute anti infective therapy (p 106) Maintain water balance by parenteral means if necessary
Helminthiasis	Isolation of ova or parasites in stool (p 1893) Give pecific anti helminthics (p 1898)
Hemorrhagic Diseases	Productive of melena Check hemogram bleeding and coagulation times (p 3706) Use transfusion for supportive therapy until specific routine can be planned

4 If difficulties persist beyond 48 hours add soluble vitamins (thiamine riboflavin niacin ascorbic acid and menadione) to infusion

5 As soon as possible resume feeding with lactic acid whole milk (p 635)

6 Consider use of specifics
   A Sulfathiazine or sulfaguanidine and streptomycin for bacillary dysenteries (p 88)
   B Emetine for amebic dysentery (p 527)
   C Penicillin or streptomycin for probatory anti infective therapy (p 106)
7 Consider use of camphorated tincture of opium (paregoric) for intractable fluid loss
8 Avoid purgatives
9 Avoid demulcents protectives and adsorbents

MARASMUS (ATHREPSIA INFANTILE ATROPHY)

Marasmus is an extreme form of malnutrition that occurs in infants under the age of one year Its etiology is varied In some instances it is associated with widespread tuberculosis celiac disease poor hygiene repeated infection prolonged residence in institutions It may also complicate severe neuropathies (hydrocephalus spastic paraplegia and mental deficiencies) prolonged diarrhea intractable vomiting and severe examples of atopic dermatitis ("infantile eczema)

At autopsy the marasmic child shows no characteristic lesion except for atrophy of subcutaneous fat and muscle There may be chronic infection or cystic disease of the pancreas

Clinical Manifestations—The striking characteristic of a marasmic baby is progressive weight loss When emaciation reaches a moderate to severe degree the skin of the face is wrinkled and hangs in folds The head appears large fontanelles are depressed eyes are sunken and sucking pads become prominent The ribs protrude and the abdomen appears either sunken or distended The temperature is subnormal and the color is that of a greyish pallor

The metabolism of fat protein and carbohydrate is not deranged unless there is some evident underlying disease that has caused the malnutrition Blood sugar is low alkali reserve is reduced the numbers of erythrocytes are diminished and there is hypoproteinemia Vitamin deficiencies become manifest most particularly as rickets and scurvy Repeated infections complicate the picture and usually bring to a close the life of the unfortunate infant

Treatment—Marasmus may be prevented by the correction of hygienic errors and a return to breast feeding Underlying or complicating infection requires removal or control by the use of sulfonamide and penicillin

Symptomatic treatment consists of the restoration of body fluid by the parenteral administration of water salt dextrose amino acids plasma and whole blood Supplementary vitamin and mineral feedings are instituted Small feedings of breast milk or formula are given at frequent intervals and the amounts are increased as soon as is compatible with the welfare of the child Hospitalized children may show extraordinary improvement when placed in foster homes or returned to maternal care

MALNUTRITION IN OLDER CHILDREN

Malnutrition in older children is one of the commonest of all pediatric complaints In many instances it is an error in diagnosis that is made by over anxious parents and not substantiated by fact Perfectly healthy youngsters of the ptotic habitus are often brought to the physician

merely because they do not deposit fat and appear frail and colorless If the physical examination is normal and the hemogram reveals no deviation the situation is simply managed by reassurance and explanation

The largest group of malnourished children presents no definite organic derangement In these a most likely accompaniment is error in dietary habits The child may eat sweets between the meals drink excessive amounts of milk suffer from overactivity and overexcitement obtain insufficient rest and exercise or rebel against being coaxed and forced to eat at table A small number of the malnourished children suffer from chronic or repeated infections of the upper respiratory tract and improve after tonsillectomy and adenoidectomy

DIFFERENTIAL DIAGNOSIS OF

Loss in Weight in Infancy

Loss of weight is of serious moment in infancy At a time when the growth stimulus is at its height profound and irreparable damage of tissue may occur from disturbances which at another time might have only minor significance

See also Loss in Weight in Adult, p 700

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Loss of 10 per cent of birth weight in first few neonatal days Prevented by feedings or injections of dextrose and saline
Hypo alimentation	Due to faulty lactation. From inadequate or poorly balanced diet From difficulties in nursing due to congenital lesions such as cleft palate In association with lesions productive of vomiting (p 2734)
Increased Energy Output	With all febrile disturbances
Enterogenous	As the result of all diarrheal states.
Neoplastic	Particularly hypernephromas of the kidney (p 2327) Note mass in lumbar region and hematuria (p 2306)
Marasmus	Extreme malnutrition before the age of one year No definite cause Later complicated by deficiency states and secondary infection
Allergic	In children with atopic dermatitis (p 3342) and food sensitivity (p 547)
Neurogenic	With congenital lesions such as hydrocephalus From trauma during delivery
Systemic Infections	Neonatal syphilis with positive serology (p 2787) Tuberculosis with positive skin reaction (p 2199)

Clinical Manifestations —The complaints of the malnourished child include anorexia constipation diarrhea nervousness habit spasm night terrors nail biting bed wetting irritability overactivity poor marks at school easy fatigability and frequent upper respiratory infections Examination reveals flabby muscles diseased tonsils enlarged adenoids carious teeth and a secondary type of anemia

Treatment—Malnutrition in older children usually requires a course of educational psychology for parents as well as child Those who have no organic disease are given complete reassurance Children with diseased ton sils or adenoids are subjected to surgical procedures Carious teeth require repair or removal Postural anomalies respond to corrective exercise and the teaching of the assumption of erect carriage Change in environment may be essential and considerable improvement may follow a few weeks or a summer at a camp or school away from parental influences All else failing psychiatric consultation is advisable

CYSTIC FIBROSIS OF THE PANCREAS

Cystic fibrosis of the pancreas is a familial disease that is characterized by marked diminution or absence of pancreatic secretion and results from congenital obstruction of large or small ducts with increase in intra or inter lobular fibrous tissue Acinar concretions are almost invariably en countered In contrast to the celiac syndrome of sprue (p 1937) cystic fibrosis occurs in the first six months of life

The presenting symptoms of cystic fibrosis are failure to assimilate fat starch and fat soluble vitamins leading to malnutrition the passage of large fatty stools and repeated respiratory infections As complications of the disturbance osteoporosis xerophthalmia vitamin K deficiency and rickets may be encountered

The diagnosis of cystic fibrosis of the pancreas is made by the discov ery of diminished or absent pancreatic enzyme in duodenal contents in crease in stool fat and decrease in blood cholesterol By contrast the celiac syndrome is characterized by the presence of pancreatic enzyme

Cystic fibrosis of the pancreas is treated in a manner similar to that of the celiac syndrome A high protein starch free fat poor diet is given supplementary feedings are hexose sucrose pancreatin and the available vitamins The list of acceptable foods includes ripe bananas banana pow der cottage cheese eggs scraped beef liver and green vegetables A pro tein milk formula may be employed for infants and this can be supple mented with banana powder

INFECTIONS OF THE NEWBORN

The neonatal period presents the curious paradox of *increased suscep tibility* and *significant immunity* to infection The former is exhibited rela tive to infections of skin umbilicus lungs gastro intestinal tract and eyes and to generalized invasions with streptococci and the organism of syphilis By contrast the newborn has a striking degree of *passive immunity* ob tained by placental transfer of antibodies from the mother As a result scarlet fever rubella mumps smallpox and poliomyelitis are almost un known during the first five months of life

The present material is limited to a discussion of infections of the um bilical cord generalized sepsis epidemic diarrhea of the newborn and neo natal syphilis

OMPHALITIS

The umbilical cord is a place of least resistance to infection Mild in flammatory processes are common causes for delayed healing of umbilical wounds which then become sources of exudate and present granulating

necrotic surfaces The reaction to these processes may be sufficient to produce fever and anorexia

The irritated stump is treated by a powder of *sulfanilamide* or a 5 per cent *sulfathiazole ointment* It is protected with a sterile dressing under which it should heal promptly

PHLEGMONOUS OMPHALITIS

Phlegmonous inflammation of the stump and the *peri umbilical tissues* may be encountered during the second or third week of life The inflammation though apparently superficial often extends deeply and may involve *peritoneum intestines* or *bladder* Invasion of peri umbilical tissues frequently leads to *umbilical arteritis* and *phlebitis* Under each and all of these circumstances the infant displays the characteristics of a sepsis whose recognition and management are next described

SEPSIS OF THE NEWBORN

Bacterial invasion of the blood stream is an ominous complication of neonatal infections It is a frequent aftermath of cutaneous infection with pyogenic bacteria and it is a common sequel of omphalitis The usual etiologic agents are *streptococci staphylococci* and *colon bacilli* but occasionally the blood culture reveals a *pneumococcus B pyocyaneus* or some other bacterial invader

Sepsis is rarely observed before the third day of life The clinical features are unique and unlike those of sepsis in the adult There may be mere *loss of appetite* and *failure to gain weight* Often there is no significant pyrexia *Jaundice* is frequent *convulsions* are common and there may be profuse subcutaneous and gastro intestinal *hemorrhages*

The physical examination may be completely normal or there may be an obvious primary focus such as furunculosis impetigo or omphalitis Less often there are obvious signs of meningitis peritonitis or pneumonia

The definitive diagnosis of sepsis requires blood cultures (p 53) *Treatment* must be vigorous with sulfonamide or penicillin and streptomycin (p 104) The infant is fortified by repeated small *transfusions* (p 3708)

EPIDEMIC DIARRHEA OF THE NEWBORN

Epidemics of highly fatal diarrhea appear with great frequency among newborn infants in hospital nurseries The cause of the condition is unknown There are no apparent differences in incidence between the sexes and babies of all races are equally susceptible No definite seasonal prevalence has been noted and the disorder is not related to the state of nutrition or the type of feeding

Pathology—Autopsy shows few pathologic changes despite the overwhelming severity of the disorder The intestinal lesions are minimal cerebral edema punctate cortical hemorrhages and pneumonitis are occasionally found

Clinical Manifestations—The clinical picture is that of a severe *intestinal intoxication* The principal features are watery yellow and green stools abdominal distention rapid weight loss drowsiness marked dehydration and shock At the onset there is little or no fever but the temperature soon rises to high levels Convulsions cyanosis dyspnea and extreme pros

tration occur fairly rapidly and precede dehydration Vomiting is not a prominent symptom It is unusual to find blood or pus in the stools and the bacteriological findings are uninformative

The earliest cases develop two days after birth but a baby may become ill as late as the twenty seventh or thirtieth day depending on the time of exposure The incubation period is approximately six days after an epi demic has begun In a severe attack, death may occur in twenty four hours or within a week Terminal otitis media and pneumonia are common While recovery in mild instances occurs within two to three weeks the general prognosis is unfavorable

Management of an Epidemic and Treatment —An outbreak of epidemic diarrhea of the newborn calls for prompt control measures Immediate closure of maternity ward and nursery is ordered Primary and secondary cases and contacts are isolated for at least three weeks The entire nursery equipment is inspected for sanitary defects and later is repainted Cul tures are taken from every possible source of contamination Repeated nose throat and stool cultures are required of infants mothers attendants and other personnel The cooperation of health authorities is sought

The treatment of the individual infant requires discontinuance of oral feeding and provision for the introduction of parenteral fluid amino acids and blood The gravity of the situation justifies the empiric use of sulfo namides (p 88) or penicillin (p 106) and streptomycin (p 104) Insoluble sulfonamides as sulfasuxidine in an initial dose of 2 gm (30 grains) per pound of body weight and maintenance doses of one sixth the initial dose every four hours merits trial With the medication protein milk may be fed to tolerance and sufficient paregoric is given in sufficient dose to limit the stools to three or four each day

NEONATAL SYPHILIS

Neonatal syphilitic infection of the fetus occurs through the placenta after the third month of gestation The effects on the infected offspring depend upon the age of the maternal lesion the adequacy of specific treat ment before and during pregnancy and a vulnerable predilection of cer tain fetal tissues particularly epiphyses skin mucocutaneous junctions liver spleen and central nervous system

Depending upon the interaction of the various contributory factors the infected fetus may be a premature or full term stillbirth with classical signs of the disease or a premature or full term infant with or without active syphilis The manifestations of *tardive heredosyphilis* absent at birth may appear later in childhood or adolescence

The Syphilitic Fetus —The stillborn premature or full term syphilitic fetus may show any of the following characteristics maceration or bullae of the skin protuberance of the abdomen collapse of the skull osteochon dritis of the epiphyses of the long bones splenomegaly positive cord Was sermann demonstrable treponemas by darkfield microscopy from cord scrapings or skin lesions a pale greasy placenta with microscopic evidences of endarteritis infarction and clubbing decreased vascularity of the chori onic villae gummas in liver or heart muscle and evidences of pulmonary fibrosis (pneumonia alba)

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The treatment of the individual infant requires discontinuance of oral feeding and provision for the introduction of parenteral fluid amino acids and blood The gravity of the situation justifies the empiric use of sulfonamides (p 88) or penicillin (p 106) and streptomycin (p 104) Insoluble sulfonamides as sulfasuxidine in an initial dose of 2 gm (30 grains) per pound of body weight and maintenance doses of one sixth the initial dose every four hours merits trial With the medication protein milk may be fed to tolerance and sufficient paregoric is given in sufficient dose to limit the stools to three or four each day

NEONATAL SYPHILIS

Neonatal syphilitic infection of the fetus occurs through the placenta after the third month of gestation The effects on the infected offspring depend upon the age of the maternal lesion the adequacy of specific treatment before and during pregnancy and a vulnerable predilection of certain fetal tissues particularly epiphyses skin mucocutaneous junctions liver spleen and central nervous system

Depending upon the interaction of the various contributory factors the infected fetus may be a premature or full term stillbirth with classical signs of the disease or a premature or full term infant with or without active syphilis The manifestations of *tardive heredosyphilis* absent at birth may appear later in childhood or adolescence

The Syphilitic Fetus—The stillborn premature or full term syphilitic fetus may show any of the following characteristics maceration or bullae of the skin protuberance of the abdomen collapse of the skull osteochondritis of the epiphyses of the long bones splenomegaly positive cord Wassermann demonstrable treponemas by darkfield microscopy from cord scrapings or skin lesions a pale greasy placenta with microscopic evidences of endarteritis infarction and clubbing decreased vascularity of the chorionic villae gummas in liver or heart muscle and evidences of pulmonary fibrosis (pneumonia alba)

DIFFERENTIAL DIAGNOSIS OF

Generalized Rashes in Eruptive Fevers

Before entering into a discussion of scarlet fever the first of the exanthems to be treated in this ection it eems fitting to deal with the broader problem of the differential diagnosis of generalized rashes in the febrile and afebrile

The day has long ince passed when the practitioner can regard the acute exanthems as consisting of measles scarlet fever rubella and chickenpox He has since learned that a generalized eruption may be an integral part of meningococcemia infectious mononucleosis spirochetal invasions (especially syphilis) or rickettsial disease (such as typhus and spotted fever) Difficulties in diagnosis are further increased by the fact that fever and a rash may result from the administration of drugs taken by self medication or prescription in an otherwise non eruptive infection such as the common cold or influenza

Conscious of the many facets to the problem the clinician therefore approaches the diagnosis of the febrile rash with caution and humility avoiding such obvious booby traps as the false positive Wassermann reaction in infectious mononucleosis and the morbilliform or scarlatiniform outbreaks caused by analgesic antipyretics sedatives sulfonamides and arsenicals He realizes that even the expert cannot differentiate eruptions by morphology alone and he does not refrain from collecting all available data before he commits himself to a definite opinion and therapeutic program

Disturbance	Type of Lesion	Herald Site	Spread	Duration from Evolution to Involution	Specific Features
Scarlet Fever	Punctate lesion with confluence to diffuse erythema	Neck chest and skin folds	Arms and legs Circumoral pallor	2 to 6 days	Schultz Charlton reaction (Fig 18 p 164)
Meningococcemia	Maculopapular petechial or purpuric (Fig 23 p 212)	Body	Shoulders and thighs	2 to 5 days	Headache and meningeal symptoms
Tularemia	Maculopapular and pustular	Body	Irregular	Irregular	Handling rodents Tick bite
Syphilis	Maculopapular erythema vesicular or pustular (Fig 49 p 338)	Irregular	Irregular	Irregular	History of chancre (p 335) Positive dark field and serology (p 337)
Rat Bite Fever	Maculopapular	Chest and arms	Irregular	Irregular	History
Typhus Fever	Macular and petechial (Fig 57 p 370)	Axilla and loins	Abdomen chest and back	2 to 10 days	Epidemic Weil Felix reaction (p 372)
Rocky Mountain Spotted Fever	Maculopapular and petechial (Fig 58 p 378)	Wrists ankles	Scalp chest abdomen	2 to 3 weeks	Tick bite

CONTINUED

Disturbance	Type of Lesion	Herald Site	Spread	Duration from Evolution to Involution	Specific Features
Dengue	Macular	Dorsum of hands and feet	Extremities face and trunk	2 to 3 days	Epidemic
Measles	Raised macular and maculopapular (Fig 65 p 411)	Behind ears	Face neck trunk and extremities	3 to 10 days	Koplik spots on buccal mucosa (Fig 64 p 410)
Rubella	Maculopapular or erythema (Fig 66 p 417)	Face	Body and extremities	1 to 3 days	Postcerv lymph adenopathy
Fourth Disease	Diffuse erythema	Face	Body and extremities	2 to 3 days	Negative Schultz-Charlton
Fifth Disease	Macular	Face	Body and extremities	2 to 10 days	No Koplik spots
Sixth Disease	Erythema or maculopapular but not raised	Neck and trunk	Spares nose and cheeks	1 to 2 days	No Koplik spots Negative Schultz-Charl ton
Chickenpox	Macules papules and then ves icles (Fig 67 p 421)	Trunk	Head, face and extrem ities	2 to 7 days	Pleomorphic Monolocular
Smallpox	Papular vesicu lar and pustular (Fig 68 p 424)	Forehead and wrists	Face arms trunk and legs	4 to 10 days	Monomorphic* Multilocular*
Infectious Mononucleo sis	Macular papu lar erythemat ous or vesicular	Irregular	Irregular	Irregular	Lymphadenop athy Hemogram (p 469)
Dermatitis Medicamen tosa	Macular papu lar vesicular urticarial (Fig 92 p 550)	Irregular	Irregular	Irregular	History of medi cation

The Living Syphilitic Infant—The living syphilitic infant *may* be com pletely free from all clinical characteristics of the disease or it may present any one of the following *manifestations* persistent rhinitis (snuffles) a hoarse high pitched cry cutaneous syphilids including maculopapular annular and bullous lesions of shiny copper red appearance with des quamation often most marked *on* palms and soles radial fissures of lips and anus with the formation of crusted rhagades healed radiating linear scars of lips and anus onychia and paronychia condylomatous lesions *of* the mucous *surfaces* particularly vulva mouth and tongue osteochondritis of the epiphyses of the long bones with pseudoparalysis or flaccid paralyses

DIFFERENTIAL DIAGNOSIS OF

Generalized Eruptive Fevers by Features Other Than the Rash

Only the bold and experienced expert assumes that it is possible to make the diagnosis of an eruptive fever by observation of the morphology of a rash For the vast body of clinicians it is necessary to weigh accompanying subjective objective epidemiologic and laboratory data before an expression of opinion is justified

Disturbances	Constitutional Symptoms	Suggestive Objective Findings	Laboratory Data	Specific Tests
Scarlet Fever	Mild to severe	Pharyngotonsillitis Strawberry tongue (Fig 20 p 177)	Leukocytosis Eosinophilia	Schultz Charlton reaction (Fig 18, p 164)
Meningococcemia	Mild to fulminating	Headache Stiff neck	Bacteremia Turbid spinal fluid with gram negative cocci (Fig 8 p 47)	Stain gram negative coccus from blood of skin lesion
Tularemia	Mild to severe	Primary papule at site of bite	Leukocytosis Agglutinins (p 59)	Bacteremia Skin test (Fig 325)
Syphilis	Absent to mild	Healed chancre	Positive darkfield (p 336)	Positive serology (p 337)
Rat Bite Fever	Mild to moderate	Bite with lymphangitis	Leukocytosis False positive Wassermann	Spirochetes on aspiration of node
Typhus Fever	Moderate to severe	None	Leukocytosis	Weil Felix reaction (p 372)
Rocky Mountain Spotted Fever	Moderate to severe	None	Leukocytosis	Weil Felix reaction (p 372)
Dengue	Moderate to severe but brief	None	Leukopenia	None
Measles	Moderate to severe	Catarrhal respiratory symptoms	False positive Wassermann (p 337)	None
Rubella	Mild	Posterior cervical lymphadenopathy	None	None
Fourth Disease	Mild	None	None	None
Fifth Disease	Mild	None	None	None
Sixth Disease	Moderate	None	Leukopenia	None
Chickenpox	Mild	None	None	None
Smallpox	Moderate to severe	None	None	None

Disturbance	Constitutional Symptoms	Suggestive Objective Findings	Laboratory Data	Specific Tests
Infectious Mononucleosis	Mild to severe	Lymphadenopathy	Mononucleosis (p 469) False positive Wassermann (p 468)	Heterophile reaction (p 468)
Dermatitis Medicamentosa	None to moderate	None	None	None

of the extremities occasional periostitis and osteomyelitis with craniotabes lymphadenopathy in the epitrochlear region evidences of meningovascular involvement with positive spinal fluid findings positive serological tests for *syphilis and malnutrition*

Tardive Heredosyphilis—Tardive heredosyphilis may not appear until the fifth year or later It may appear in children who have previously seemed to be normal and in those who have had inadequate treatment

The most frequent clinical evidences of late childhood syphilis include interstitial keratitis trophic changes in the permanent upper central incisors (Hutchinson s teeth) mulberry molars peg teeth periostitis and osteitis of the tibias and fibulas (saber shin) bosses on the frontal bones saddle deformity of the nose dactylitis hydrarthrosis (Clutton s joints) partial or complete eighth nerve deafness evidences of meningitis juvenile preparesis juvenile tabes mental retardation gummas of skin nose throat and other organs choroiditis retinitis optic atrophy pupillary changes lymphadenopathy paroxysmal hemoglobinuria positive serology of the blood (66 per cent) *and positive findings in the cerebrospinal fluid*

Treatment—The prevention of neonatal syphilis is accomplished by the legal demand for blood serologies premaritally and following impregnation. The premarital test prevents the marriage of infected individuals the pre-pregnancy test permits early recognition and prompt treatment of the woman who has been infected following marriage and before the birth of her baby

The treatment of neonatal syphilis is best conducted before the birth of the child Remarkable results have been obtained both with intensive arsenotherapy by the intravenous drip (five day treatment) and by the safer method using penicillin With either of these methods it is unusual for the infant to show clinical or serologic evidences of the infection In the few instances in which maternal therapy has not been wholly successful the syphilitic offspring may be treated most safely with penicillin or by a modification of five day treatment in which a total of 120 to 180 mg of mapharsen is employed Longtime observation of blood and spinal fluid is essential with re treatment upon evidence of recurrence

DIFFERENTIAL DIAGNOSIS OF

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Dengue	Moderate to se e e but brief	None	Leukopenia	None
Measles	Moderate to severe	Catarrhal respiratory symptoms	False positive Wassermann (p 337)	None
Pubella	Mild	Po terior cervical lymphadenopathy	None	None
Fourth Disease	Mild	None	None	None
Fifth Disease	Mild	None	None	None
Sixth Disease	Moderate	None	Leukopenia	None
Chickenpox	Mild	None	None	None
Smallpox	Moderate to severe	None	None	None

SECTION XIX

THE SKELETAL AND LOCOMOTOR SYSTEMS

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CHAPTER 130

INTRODUCTION PHYSIOLOGY METHODS OF DIAGNOSIS AND TREATMENT

The bony structures involved in support and locomotion consist of skeleton and its investments joints or articulations with their cartilages synovia and bursae muscles and tendons and the ubiquitous connective tissue envelope and stroma

Unlike plants which live and die where fate has cast their seeds animals are enabled by some form of locomotion to alter their environmental conditions Additionally man is differentiated from other creatures in that he has assumed the upright posture and normally employs only his legs for purposes of locomotion The powers to move about and stand erect particularly the latter have evolved laboriously and painfully As a result postural and skeletal abnormalities are almost universally encountered At one time or another almost every individual suffers from low back pain fallen arches varicose veins and corns or bunions Few human beings go through life without experiencing a fracture of bone or a sprain or dislocation of a joint

The general practitioner deals with disturbances of the organs of support and locomotion as part of his everyday experience since many skeletal disabilities are handled satisfactorily without recourse to unusual technical skill and training The more complicated procedures are the province of the *orthopedic surgeon* with whom the practitioner will enjoy some of the most satisfactory experiences in medicine In institutional work this specialist performs his most spectacular achievements in the field of operative surgery In private practice he is used for the most part to assist and instruct the practitioner in the *conservative* and highly gratifying management of the commoner disturbances

EMBRYOLOGY AND HISTOLOGY OF BONE GROWTH

The histologic manifestations of bone growth are identical in embryologic development and in adult phases Ossification takes place by an endochondral mechanism by periosteal deposition, and by an intramembranous process of bone growth

Endochondral Ossification.—Endochondral or enchondral ossification is the usual method of bone growth and is best observed at the end of long bones In early life an ossific center appears at cartilaginous ends cartilage cells adjacent to the young bone arrange themselves in columns cartilage matrix between the columns degenerates and young bone cells invade intercolumnar spaces and deposit new bone on the columns The new bone is osteoid at first but later it calcifies rapidly and assumes the normal structural characteristics of osseous tissue

By this method of endochondral ossification epiphyseal centers increase rapidly in size and replace the cartilages of the head of the bone To provide for growth in length a cartilaginous plate persists between epiphysis and diaphysis and at the end of the bone a thin layer of articular cartilage enters into the joint.

Abnormalities in the conversion of cartilage to bone are responsible for certain growth derangements such as *achondroplasia* and *dyschondroplasia* (p 2 98)

Periosteal Deposition.—Growth of bone by *lamellation* is effected by cells of the perios-

PHYSIOLOGY OF BONE AND CARTILAGE

The physiology of bone depends upon a complex variety of chemical processes. These include the intake, absorption and output of calcium, the physical state of the lime, the acidity and gaseous contents of the fluids of cells and tissues, calcium-phosphate interrelationships, the presence or absence of vitamin D, the normal secretions of the parathyroid, thyroid, pituitary and perhaps the gonads, the vascularity of bone, and the factors of use and disuse.

Concerning most of these processes there is little information available to the clinician. At best, blood calcium and phosphate levels and phosphatase figures can be determined. Even these analyses are difficult to obtain except in the well-equipped laboratories of large institutions, so that, in the final analysis, the practitioner is dependent for information upon clinical data.

Calcium Metabolism.—Bone is composed of five-sixths *calcium phosphate* and one-sixth *calcium carbonate*. These salts are not deposited in an inert fashion but are constantly seeking equilibrium with the ions of blood and tissue fluids.



Fig. 00.—A photomicrograph (X 2 0) showing active subperiosteal new bone formation in the femur of an infant. The most recently formed osteoid matrix may be seen as lightly stained osteoid seams (A) beneath the rows of osteoblasts (B).

The calcium required for bone formation is supplied in foods. Despite the fact that milk and other dairy products are high in lime content, calcium deficiency is one of the commonest deficiencies in the American dietary. Parenthetically it may be stated that this furnishes the only rational indication for calcium therapy in metabolic derangements of the osseous system.

The regulation of calcium metabolism provides for a wide margin of safety. With an excess of ions in the blood, there is a deposition or storage in bone. When osseous structures have become optimally calcified, additional calcium is excreted in urine or feces, and when the calcium level of the blood falls, osseous structures liberate soluble calcium for tissue needs. See Hyperc lcemia (p. 723), Hypocalcemia (p. 21)

Beside the simple mechanism of supply and demand, other more intricate factors participate in calcium economy. The physical state of the ion may be an incorporation in a soluble or insoluble salt. The element may be free and easily accessible or inextricably bound in some complicated molecular structure. The physical state and solubility of calcium depend upon such diverse phenomena as the hydrogen ion concentration of blood and tissues, carbon

Scudder: The Treatment of Fractures

teum Concentric layers are deposited to increase the thickness of bone structure which soon becomes differentiated into outer compact cortex and central spongy or cancellous stratum.

Cortical Bone—Adult cortical bone is composed of layers (lamellae) of a dense, hard substance which is chemically a mixture of calcium phosphate and calcium carbonate The lamellae are arranged parallel to periosteum with small spaces between the layers for bone cells or *osteocytes* Calcium phosphates and carbonates are deposited extracellularly upon a ground surface of *collagen fibers*

The lamellae tend to group themselves circumferentially about minute capillaries which penetrate bone in every direction The capillaries run in *haversian canals* each canal with its circumferential lamellae forms a *haversian system*

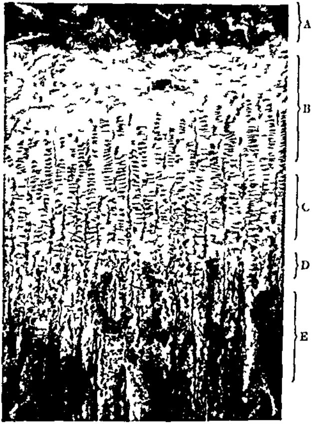


Fig 699—The cartilaginous epiphyseal end of a radius from a six weeks-old dog *A* The ossification center *B* The zone where multiplication and orderly arrangement of cell columns take place *C* The zone where hypertrophic and degenerating cartilage cells are observed. *D* The zone of capillary invasion This is spoken of as the zone of provisional calcification (See Fig 700) *E* The metaphyseal end of the diaphysis In this zone one observes the process of new bone formation Bone matrix is deposited on the remaining calcified cartilage trabeculae (Photomicrograph × 143 of a hematoxylin and eosin stained section)*

Cancellous Bone—Central spongy or cancellous bone is made up of a network of interlacing *trabeculae*. The spaces between trabeculae are filled with *marrow* which may be red marrow indicating predominance of hematopoetic elements or yellow marrow which is principally fatty in nature

Intramembranous Ossification.—Certain flat bones notably the skull vault and clavicle are formed by intramembranous ossification Osteoid bone is laid down directly in the interlacing meshes of fibrous tissue and later becomes calcified

* Scudder The Treatment of Fractures.

Renal Insufficiency	Deformities of shafts and epiphyses with dwarfism (p 2275)
Rickets	Disordered calcium and phosphorus metabolism dependent upon insufficiency of vitamin D Epiphyseal activity impaired Calcification imperfect Bone relatively soft, giving rise to a great variety of abnormalities (p 2850) Note therapeutic response to adequate intake of vitamin D and calcium (p 620)
Synostosis of Cervical Spine	*Klippel Feil syndrome with congenital fusion of lower cervical vertebrae into one homogeneous structure (p 2817)*

dioxide and oxygen tensions of body fluids concentration of phosphate hormonal balance and the vascularity of local structures

Effect of Changes in Hydrogen Ion Concentration.—A state of alkalosis (p 722) produced by so simple a mechanism as the excessive ingestion of alkalies in the treatment of gastric ulcer may precipitate the patient into a state of low-calcium tetany exactly as is produced by removal of the parathyroid glands

Calcium Metabolism and Tension of Gases.—Calcium metabolism is intimately bound up with the tension of carbon dioxide By the simple device of *hyperventilation* a clinical tetany can be produced

Calcium Metabolism and Vitamin D.—The presence of vitamin D is an exceedingly important factor in the economy of calcium Absence of or diminution in the supply of vitamin D results in failure of bone to calcify even if the supply of accessible calcium is adequate or more than adequate As a result, the site of greatest bone growth, namely the epiphysis shows a striking disturbance which constitutes the syndrome of *rickets* In the adult, vitamin D *deficiency produces osteomalacia* in which the decalcification is more diffuse since the metabolism of all parts of the bony skeleton is more or less on a parity basis

Calcium Metabolism and Retention of Phosphate.—Calcium metabolism is dependent upon changes that occur in the economy of phosphate With a high concentration of phosphate calcium is mobilized out of bone and into the blood stream after which it is excreted, producing the clinical condition of *renal rickets*

Calcium Metabolism and the Parathyroids.—The internal secretion of the parathyroid glands acts to increase the level of blood calcium and hence mobilizes calcium from its reservoirs in bone In *hyperparathyroidism* bones decalcify to the extent that pathologic fractures are observed In contrast to this removal or destruction of parathyroid glands such as occurs occasionally in the course of thyroidectomy for hyperthyroidism results in a hypoparathyroidism sufficient to produce the clinical state of tetany

Besides the parathyroid gland other internal secretory structures modify bone growth In thyroid deficiency epiphyseal growth is slowed and ossification lags resulting in the type of dwarfism that is seen in cretins Hyperthyroidism may produce *osteoporosis* Excessive pituitary activity leads to a more rapid growth of the epiphysis and results in *giantism* when younger patients are afflicted and to *acromegaly* when the disturbance affects the individual who is already fullgrown Pituitary deficiency results in *dwarfism*

The relationship of the gonads to bony growth is of particular importance to the clinician since the menopause and senility are often associated with degenerative phenomena involving cartilage and bone These abnormalities are more fully discussed with the material on *osteo-arthritis* more popularly known as hypertrophic arthritis or "arthritis deformans" (p 265-)

Calcium Metabolism and Local Vascularity.—The chemical interchange of calcium between serum and bone depends upon the state of the local circulatory elements This is best illustrated by contrasting the results of excessive activity and immobilization The highly muscular individual exhibits hypertrophic bones which contain an excess of calcium Inactivity as when an extremity is immobilized in a plaster cast, results in decalcification and atrophy Under the latter circumstance the calcium liberated from bone is excreted in urine and feces The excess may be so great as to result in the appearance of *urinary calculi* (p 2311)

A more subtle and important change occurs when local blood supply is impoverished.

DIFFERENTIAL DIAGNOSIS OF

Disturbances of Ossification

Most disturbances of ossification are of congenital origin probably due to endocrine dysfunction In the adult abnormalities are noted as the result also of vitamin deficiency and syphilis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Achondroplasia	Chondrodystrophia foetalis of congenital and hereditary origin Premature union of epiphyses and dwarfism (p 2878)
Cretinism	Thyroid deficiency Retarded growth at epiphyseal centers and dwarfism. Note low B.M.R. Therapeutic response to thyroid extract (p 1189)
Dwarfism	Ateleiosis of idiopathic and congenital origin Try anterior pituitary growth hormone and thyroid extract (p 694)
Dyschondroplasia	Disordered osteogenesis Multiple osteochondromas at extremities of long bones (p 2878)
Giantism and Acromegaly	Anterior pituitary hyperactivity Acceleration of growth at epiphyseal line Giantism before adult stature has been attained, acromegaly after epiphyses have closed. X ray sella turcica Consider reference to neurosurgeon.
Hyperparathyroidism	Generalized osteitis fibrosa cystica with hypercalcemia and hypophosphatemia (p. 1225) Consider exploration of parathyroid region
Hypogonadism	Increased activity of epiphyseal centers and accelerated growth, before puberty (p 2412) May cause osteoporosis or osteo-arthrosis after menopause or male climacteric Consider administration of estrogen or androgen (pp 2401 2515)
Leontiasis Ossium	Thickening of bones of cranium and face giving lion like appearance (p 2878) Examine nasal accessory sinuses for evidences of chronic infection (p 2125)
Melorheostosis	Flowing hyperostosis of extremities of bone giving appearance of dripping of candle-wax (p 2878)
Osteitis Deformans	Paget s disease with thickening and bowing of cortex of long bones Usual appearance of enlargement of skull and bowing of legs (p 2879)
Osteogenesis Imperfecta	Fragilitas ossium. Pathologic fractures blue sclerae and deafness (p. 2879)
Osteomalacia	Adult rickets with contracted pelvis and dystocia (p 2853)
Osteopetrosis	Albers-Schonberg disease Diffuse increase of bone density pathologic fracture and myelophthisic anemia Of congenital origin (p. 2879)
Osteopoikilosis	Of congenital origin Small and limited areas of increased density (p 2879)

CONTINUED

Atrophy and Decalcification.—Atrophy and decalcification of bone result from many different causes. Thus *prolonged continuous pressure* results not in hypertrophy but atrophy as in erosion of a vertebra due to an aortic aneurysm. Bones also undergo atrophy and decalcification *from disuse* when immobilized in a plaster cast and in *senility* by a mechanism not yet understood.

Chemical atrophy and decalcification follow a wide variety of causes as previously discussed in the section on calcium metabolism. Thus an inadequate calcium intake, hyperparathyroidism or an acidosis may be productive of demonstrable radiographic changes characterized by a generalized diminution in the density of the compact cortical layer. Decalcification of bone may be caused by *hyperemia* when bone tissue is displaced by overgrowth of vascular tissue. Sudeck's atrophy probably exemplifies this mechanism.

Aseptic Necrosis.—When the blood supply to a section of bone is cut off the metabolic phenomena are immediately arrested and the infarcted section of bone "dies." The infarcts of bone may be due to fracture, especially of the head of the femur, embolism, caisson disease or thrombosis. The infarcted bone remains unchanged in density as viewed in the radiograph. The remainder of the bone undergoes atrophy of disuse and appears deceptively lighter by comparison.

During childhood when the epiphysis is actively growing, aseptic necrosis occurs in a slowly developing manner due to causes and circumstances not clearly understood.

Disturbances of Cartilage.—When the nutrition of cartilaginous cells becomes impoverished the cartilage takes on a fibrillated and yellowish appearance and may actually die. Under these circumstances it can never be regenerated so that the process is irreversible. The gap in the articular cartilage is replaced by an inferior type of fibrocartilaginous tissue.

METHODS OF DIAGNOSIS

The easy accessibility of the skeletal and locomotor structures makes for a direct and satisfactory approach to physical examination. Much can be learned by inspection noting *atrophies, hypertrophies, irregularities* and *alterations in movement or gait*. The *ranges of motion* are accurately measured and in the extremities the opposite limb serves as a control. *Muscle strength* is easily tested and the local vessels and nerves are examined. Unusual conditions require consultation with the specialist orthopedist.

JOINT ASPIRATION

Aspiration of a joint is a procedure which is often done by the practitioner. The most common joint aspirated is the knee but nearly all the major joints with the exception of the hip joint are fairly close to the surface and can be reached by the aspirating needle without difficulty. The hip joint presents somewhat more difficulty but it can be reached by an aspirating needle inserted just lateral to the femoral vessels.

The aspiration should be performed under strict aseptic precautions. The joint should be widely painted with iodine and draped with a sterile towel. The operator should wear sterile gloves. The site of aspiration in the *knee may be selected at any of the four corners of the patella, either* superolateral or superomedial or inferolateral or inferomedial. The superolateral border of the patella is the region most frequently selected. A small skin wheal is raised with 2 per cent procaine and a fairly large bore long needle is inserted obliquely downward behind the patella until the joint is reached. After the material has been aspirated by a sterile syringe a dressing is placed over the needle hole and a pressure bandage is applied. *The material obtained may be examined by smear, culture or guinea pig* inoculation if indicated.

Under these circumstances the interchange between serum and bone may cease and an *aseptic necrosis* of bone occurs in the devascularized area. This is seen particularly in childhood at the growing epiphyses giving rise to a whole series of otherwise inexplicable phenomena such as *vertebral osteochondritis*, *Perthes disease*, *Osgood-Schlatter disease*, *Freiberg-Kohler* and *Kienbock's disease* (p 2329)

Chemical Factors Other Than Calcium—In addition to calcium other chemical factors are related to disturbances of the skeletal and locomotor systems. In *gout* (p 286) there is an obvious abnormality of *uric acid metabolism* with resulting deposits in the subcutaneous and articular tissues and bone changes are seen in the *lipoidoses* (p 1132)

ANATOMY AND PHYSIOLOGY OF THE JOINTS

The articular surfaces of bones are covered with *cartilage* and lined by a continuous *synovial membrane*. Each joint contains *synovial fluid* which is a lubricating secretion derived from synovial membrane. Finally articular ends of bones, synovial membranes and synovial fluid are surrounded by *ligamentous joint capsules*, *muscles* and *tendinous attachments*. Some of the joints, notably the knees, temporomandibular and sternoclavicular articulations, have an *interarticular fibrocartilage* which acts to stabilize surfaces and diminish shocks and jars.

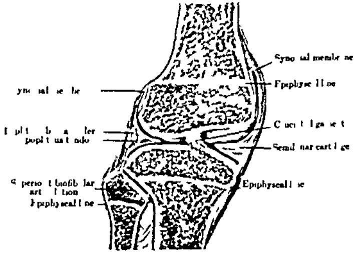


Fig 01—A coronal section through the knee joint. The epiphyseal line of the tibia is extra articular to the knee joint. The epiphyseal line of the fibula is likewise extra articular. The epiphyseal line of the femur is extra articular on the outer side. On the inner side the synovial membrane of the knee joint overlaps the epiphyseal line.*

About most joints are *bursae*, synovial sacs filled with viscous fluid to facilitate the gliding of the tendons over each other and over underlying bone. Bursae are also present in certain areas such as the elbow and the region of the knee where the skin is closely applied to subcutaneous bone and hence subjected to pressure.

PATHOLOGY OF BONE AND JOINTS

The specific pathology of bones and joints is concerned with the processes of hypertrophy, atrophy and decalcification with aseptic necrosis and the vascular disturbances that involve cartilage.

Hypertrophy—Bone reacts to *interrupted pressure* by hypertrophy or the production of an *exostosis*.

Exostosis—An exostosis is the result of periosteal new bone deposition. Of similar origin is the involucrum surrounding an area of osteomyelitis. Localized hypertrophy of bone is also noted surrounding low grade bone infections (*Brodie's abscess*) or tumors (*osteoid osteoma*).

Following the healing of fractures a temporary excess of bone remains at the fractured site giving rise to a bony swelling which may be palpable in superficial bones.

* Thompson Annals of Surgery 1918

Atrophy and Decalcification.—Atrophy and decalcification of bone result from many different causes Thus *prolonged continuous pressure* results not in hypertrophy but atrophy as in erosion of a vertebra due to an aortic aneurysm Bones also undergo atrophy and decalcification from *disuse* when immobilized in a plaster cast, and in *senility* by a mechanism not yet understood

Chemical atrophy and decalcification follow a wide variety of causes as previously discussed in the section on calcium metabolism Thus an inadequate calcium intake hyperparathyroidism or an acidosis may be *productive of demonstrable radiographic changes* characterized by a generalized diminution in the density of the compact cortical layer *Decalcification of bone may be caused by hyperemia* when bone tissue is *displaced by overgrowth of* vascular tissue Sudeck's atrophy probably exemplifies this mechanism

Aseptic Necrosis.—When the blood *supply* to a section of bone is cut off, the metabolic phenomena are immediately arrested and the infarcted section of bone "dies" The infarcts of bone may be due to fracture *especially* of the head of the femur embolism, caisson disease or thrombosis The infarcted bone remains unchanged in density as viewed in the radiograph The remainder of the bone undergoes atrophy of disuse and appears deceptively lighter by comparison.

During childhood when the epiphysis is actively growing aseptic necrosis occurs in a slowly developing manner due to causes and circumstances not clearly understood

Disturbances of Cartilage.—When the nutrition of cartilaginous cells becomes impoverished, the cartilage takes on a fibrillated and yellowish appearance and may actually die. Under these circumstances, it can never be regenerated so that the process is irreversible The gap in the articular cartilage is replaced by an inferior type of fibrocartilaginous tissue

METHODS OF DIAGNOSIS

The easy accessibility of the skeletal and locomotor structures makes for a direct and satisfactory approach to physical examination Much can be learned by inspection noting *atrophies hypertrophies irregularities* and *alterations in movement or gait* The *ranges of motion* are accurately measured and in the extremities the opposite limb serves as a control *Muscle strength* is easily tested and the local vessels and nerves are examined Unusual conditions require consultation with the specialist orthopedist

JOINT ASPIRATION

Aspiration of a joint is a procedure which is often done by the practitioner The most common joint aspirated is the knee but nearly all the major joints with the exception of the hip joint are fairly close to the surface and can be reached by the aspirating needle without difficulty The hip joint presents somewhat more difficulty but it can be reached by an aspirating needle inserted just lateral to the femoral vessels

The aspiration should be performed under strict aseptic precautions The joint should be widely painted with iodine and draped with a sterile towel The operator should wear sterile gloves The site of aspiration in the knee may be selected at *any of the four* corners *of the patella* either superolateral or superomedial or inferolateral or inferomedial The superolateral border of the patella is the region most frequently selected A small skin wheal is raised with 2 per cent procaine and a fairly large bore long needle is inserted obliquely downward behind the patella until the joint is reached After the material has been aspirated by a sterile syringe a dressing is placed over the needle hole and a pressure bandage is applied The material obtained may be examined by smear culture *or guinea pig* inoculation if indicated

DIFFERENTIAL DIAGNOSIS OF

Polyarthralgia

In most instances multiple joint disturbances suggest the operation of a systemic rather than a local cause The practitioner therefore conducts his investigation along very broad lines.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Metabolic	
Allergy	Often associated with serum sickness (p 2878)
Gout	Metabolic disorder of purin metabolism. Note high blood uric acid, tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine (p 2874)
Osteo-arthrosis	Metabolic disturbance usually in obese middle-aged patients with hypometabolism. Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces, lipping and spur formation (p 2855) Normal temperature and sedimentation rate No muscle atrophy Institute complete therapeutic routine (p 2862)
Rickets	Wide-spread epiphyseal disturbance. Therapeutic response to vitamin D and calcium (p 2850)
Scurvy	Blood effusion due to capillary damage Therapeutic response to cevitamic acid (p 1120)
Infectious and Inflammatory	
Brucellosis	With relative or absolute pyrexia Note brucellergin reaction (p 314)
Cerebrospinal Meningitis	Gram negative organisms demonstrable in blood, joint fluid or spinal fluid (p 208) Use intensive penicillin and sulfonamide therapy (p 106)
Coccidioidomycosis	Desert rheumatism Seek evidences of coccidioidal infection elsewhere Attempt to identify organism in joint fluid (p 499)
Gonococcemia	History of venereal infection. Gram negative organism in blood or joint fluid (p 217) Start intensive treatment with penicillin (p 106)
Influenza	Without local demonstrable signs
Rheumatic Fever	With relative or absolute pyrexia rapid sedimentation rate and carditis Note therapeutic response to salicylate (p 186)
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine (p 2925)
Syphilis	Usually monarticular except in neonatal infections Note positive Wassermann and therapeutic response to penicillin (p 240)

CO

Tuberculosis	Usually monarticular but occasionally polyarticular Note evidences of tuberculosis elsewhere Do tuberculin test (p 252)
Disturbances of Blood	
Hemophilia	Note prolonged coagulation time (p 118)
Hemorrhagic Capillary Toxicosis	Henoch s purpura with cutaneous eruption (p 3424) Try therapeutic response to salicylate

DIFFERENTIAL DIAGNOSIS OF

Monarthralgia

Pain in the region of a single joint may be due to an isolated localization of one of the disturbances productive of polyarthralgia (p. 2802) Additionally however the discomfort may be due to purely local phenomena

CLINICAL MANIFESTATIONS	AND DIAGNOSTIC FEATURES
Congenital Anomalies	Dislocation of hip with shortening of leg abnormal range of motility and characteristic x ray signs Refer to orthopedist for treatment
Epiphyseal Disturbances	In the growing child. Of hip (Legg-Calvé Perthes disease (p 2929) Of knee (Osgood Schlatter s disease (p 2929) Of foot (Freiberg Kohler s disease (p 2929) Of wrist (Kienbock s disease (p 2929) *Get x rays and refer* to orthopedic surgeon.
Infections and Inflammations	
Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylococcemia meningococcemia gonococcemia brucellosis tuberculosis or mycoses Look for pathogen (p 2910) Try anti infective treatment (p 106)
Osteomyelitis	*Particularly following compound* injuries involving joints (p 2930) Get x rays
Fibromyositis	With localized induration of soft tissues Try therapeutic response to injections of procaine (p 2894)
Tenosynovitis	With localized friction rub or direct tenderness (p 2901)
Bursitis	Films reveal depositions of calcium particularly in the shoulder (p 2904)
Trauma	Injuries to joints articular surfaces of bone or epiphyses Check x rays
Psychogenic	Contractures in hysteria (p 1367)
Neurogenic	Charcot s joint in tabes dorsalis and syringomyelia Note sensory dissociation in latter (p 1505) Check cerebrospinal fluid in tabes (p 1464)
Referred Pain	Particularly to knee with hip lesions Get x rays of both joints before expressing any opinion.
Neoplasms	Particularly bone malignancies involving articular or epiphyseal ends (p 2835) Refer to orthopedist for biopsy and recommendations as to therapy

ASPIRATION BIOPSY

Aspiration biopsy is a simple safe convenient method of obtaining tissue for analysis Under strictly aseptic precautions the skin is anesthetized with procaine A large bore needle attached to a record syringe is inserted down to the tissue to be aspirated The needle is then rotated and slid gently back and forth within the tissue while strong suction is made upon the syringe It is then withdrawn while suction is maintained and the material is blown out onto a slide for examination It may be necessary to wash the bore of the needle with saline solution to recover small adherent bits of tissue The material may be fixed stained and examined almost at once without requiring sectioning Aspiration of bony tissue is possible by this method provided that the bone is cancellous but the needle will not penetrate cortical bone

Indirect methods of diagnostic examination yield relatively minor information Profound abnormalities in *calcium* and *phosphate metabolism* may be indicated by the blood examinations increase in acid phosphatase occurs in metastatic prostatic carcinosis, in the presence of marked infection especially with pyogens, there may be a nonspecific *leukocytosis* and an increase in the *sedimentation rate*

DIFFERENTIAL DIAGNOSIS

Problems in the differential diagnosis of disturbances of the skeletal and locomotor systems are presented in the following tables

Thoracic and Upper Lumbar Pain (p 2940)
Shoulders and Upper Extremities Painless Swellings and Deformities of (p 2954)
Dislocations and Subluxations (p 2965)
Fractures of Face and Jaws Spine Pelvis and Thorax (p 3004)
Shoulder Girdles and Upper Extremities (p 3014)
Hips and Lower Extremities (p 3038)
Scoliosis (p 3060)
Kyphosis (p 3062)
Lordosis (p 3063)
Low Back Pain (*Lumbago*) (p 3072)
Inguinal Swellings and Tumors (p 3092)
Osteo arthrosis and Rheumatoid Arthritis (p 2862)

AIDS IN DIFFERENTIAL DIAGNOSIS OF INCREASED RADIOTRANSLUCENCY OF BONE (DECALCIFICATION)

1 An *isolated lesion* occurring *before adolescence* is most likely an osteochondroma a bone cyst a giant cell tumor an osteogenic sarcoma or an endothelial myeloma *Beyond the age of 40* either isolated or multiple lesions suggest multiple myeloma and metastatic carcinomatosis

2 Chondromas osteochondromas and endothelial myelomas are situated *in the shaft* giant cell tumors bone cysts and osteogenic sarcomas occur at the *ends* of bone

3 The *association of pain* suggests a giant cell tumor osteoid osteoma osteogenic sarcoma endothelial myeloma multiple myeloma metastatic carcinoma osteomyelitis or gout

4 *Pathologic fractures* are most apt to occur with chondromas solitary bone cysts endothelial myelomas multiple myelomas metastatic carcinomas and in association with hyperparathyroidism

5 The presence of *fever* suggests endothelial myeloma metastatic carcinoma gout or osteomyelitis

6 The *general physical examination* may reveal findings that are suggestive of the nature of the bone lesion Thus following pregnancy an osteomalacia is a most likely cause the presence of tophi intimates that the primary condition is a gout splenomegaly is associated with Gaucher s syndrome one of the reticuloendothelioses blue sclerotics occur in osteogenesis imperfecta the presence of tuberculosis in lungs or urinary passages suggests that the osseous lesion also is caused by the acid fast bacillus

7 Clues from *laboratory examinations* include the presence of Bence Jones proteose in multiple myeloma and of a large quantity of urine with low specific gravity in the xanthomatoses hypercalcemia suggests hyperparathyroidism whilst elevation of uric acid figure points strongly to a gout in metastases from prostatic lesions an increase in blood acid phosphatase is present myeloma and Gaucher cells can be identified in smears made of bone marraw an elevation of the basal metabolic rate signifies hyperthyroidism bacteremias are demonstrable in pyogenic osteomyelitis a positive Wassermann suggests but does not prove that the skeletal lesion is syphilitic and warrants a therapeutic test

ASPIRATION BIOPSY

Aspiration biopsy is a simple, safe convenient method of obtaining tissue for analysis Under strictly aseptic precautions the skin is anesthetized with procaine A large bore needle, attached to a record syringe is inserted down to the tissue to be aspirated The needle is then rotated and slid gently back and forth within the tissue while strong suction is made upon the syringe It is then withdrawn while suction is maintained and the material is blown out onto a slide for examination It may be necessary to wash the bore of the needle with saline solution to recover small adherent bits of tissue The material may be fixed stained and examined almost at once without requiring sectioning Aspiration of bony tissue is possible by this method provided that the bone is cancellous but the needle will not penetrate cortical bone

Indirect methods of diagnostic examination yield relatively minor information Profound abnormalities in *calcium* and *phosphate metabolism* may be indicated by the blood examinations increase in acid phosphatase occurs in metastatic prostatic carcinosis in the presence of marked infection especially with pyogens, there may be a nonspecific *leukocytosis* and an increase in the *sedimentation rate*

DIFFERENTIAL DIAGNOSIS

Problems in the differential diagnosis of disturbances of the skeletal and locomotor systems are presented in the following tables

Osteogenesis Imperfecta	Of congenital origin with blue sclerae and deafness
Albright s Disease	Fibrocystic disease of infants With progeria (p 2524)

8 For definitive diagnosis a *bone biopsy* is clearly indicated and warranted

9 In *metastatic carcinomatosis* of bone the primary lesion is most likely in breast bronchus kidney thyroid prostate or stomach

THE ORTHOPEDIC SURGEON

The orthopedic surgeon should be consulted in dealing with diagnostic problems of the following type

1 *Low back pain* (p 3072)
2 *Sciatica* (p 3072)
3 *Diseases of the neuromuscular system* including neuralgias neuritis muscular atrophies and dystrophies
4 *Diseases of the skeletal system and joints* particularly when acute inflammation or a fracture is suspected
5 *Goniometry*
6 *Disturbances in gait* (p 3496)
7 *Disturbances in the lower limbs* (pp 2826 2868)

Goniometry—The *length* of an extremity may be estimated by x ray examination or by clinical measurement between bony prominences This latter is the more usual method The upper extremity is rarely measured because of the lack of practical importance of shortening in this region In the lower extremity slight differences in length may cause substantial difficulties in gait hence measurement of the length of the lower extremity should be a part of every routine orthopedic examination The length of the entire lower extremity is generally measured between the internal malleolus of the tibia and the anterior superior spine of the pelvis This measurement is the actual length as differented from the less reliable apparent length measured to the umbilicus

Range of Motion—The fortunate bilaterality of the extremities gives the orthopedic surgeon an extremely convenient standard of comparison not enjoyed in other specialties such as cardiology or internal medicine Estimation of the *range of motion* is of great importance in disturbances of the joints and periarticular structures (p 2894) In unilateral disease the uninvolved joint is used for the norm

ANALGESIC BLOCK

Referred or reflex pain can be differentiated from deep local pain by induction of analgesic block The sore patch of skin is surrounded by a circular intracutaneous wheal of 1 per cent procaine which effectually eliminates mere skin tenderness but has no effect on deep sensitivity

Additionally trigger points in the erector spinae gluteal lumbosacral sacro iliac and other low back structures may be infiltrated with 5 cc of

DIFFERENTIAL DIAGNOSIS OF

Increased Radiotranslucency of Bone (Decalcification)

Increased radiotranslucency of bone occurs when osseous tissue is decalcified or replaced by a substance which is not lime-containing. Radiotranslucency may be demonstrable in a localized area or it may involve the greater portion of the skeletal system. In any event, the finding requires intensive investigation by the practitioner since the circumstance is always of serious moment.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Isolated Areas of Radiotranslucency

Infection	Acute or chronic pyogenic osteomyelitis usually staphylococcal streptococcal or typhoidal. Get blood culture. Start anti infective treatment (p 106). Consider curettage for smears and cultures. Tuberculous osteomyelitis (p 2942). Get x rays. Look for acid fast lesions elsewhere (p 2193)
Neoplasm	Benign or malignant primary growths of bone. Consider exploratory operation for purposes of diagnosis and therapy. Isolated metastatic malignancy. Look for primary growth elsewhere in the body

Generalized Radiotranslucency of Bone

Neoplasm	Metastatic deposits with demonstrable primary growth elsewhere. Multiple myeloma with Bence Jones proteosuria and myeloma cells in marrow smears (p 1126)
Metabolic Disturbance	
Osteoporosis	In senility or chronic illness. With atrophy of disuse (p 2517)
Osteo-arthrosis	Metabolic disturbance usually in obese middle-aged patients with hypometabolism. Involvements of spine weight bearing and distal interphalangeal joints (p 2855). X rays show narrowed joint spaces lipping and spur formation (p 2861). Normal temperature and sedimentation rate. No muscle atrophy. Institute complete therapeutic routine (p 2862)
Hyperparathyroidism	With hypercalcemia hypophosphatemia and bone cyst formation. Consider exploration for removal of adenomas (p 1225)
Gout	Metabolic disorder of purin metabolism. Note high blood uric acid, tophi and sodium urate deposits. Try therapeutic test with colchicine (p 2867)
Reticulo endothelial Lipoidosis	With associated xanthomas cranial nerve palsy diabetes insipidus splenomegaly or lesions of the optic nerve (p 1133)
Hyperthyroidism	With elevated B M R. Therapeutic response to iodide or Deracil (p 1197)
Osteomalacia	With history of vitamin deficiency (p 2853)

CORRECTIVE EXERCISE AND BRACES

An important function of the orthopedist is instruction in *corrective exercise* (p 3757) and when necessary the application of appliances braces and upports

Appliances and braces are removable supports designed to maintain a position in which a weakened muscle or ligament is relaxed They include back braces supportive corsets arch supports corrective shoes and braces for the extremities and collars of various types to support the cervical spine

OFFICE ORTHOPEDICS

Office orthopedics includes the care of patients who present static dis turbances neuromuscular disability peripheral vascular disorders and dis turbances involving the bones and joints

The orthopedist suggests *corrective exercise* (p 3757) he fits and meas ures *shoes arch supports corsets* and *braces* his assistance is sought in the *reduction of dislocations* (p 2964) and the treatment of *fractures* (p 2982) he performs *manipulative treatment* (p 3064) in conditions in volving adhesions in and around the joints his services are used in the *aspiration* (p 2801) of *joint effusions and bursal swellings* he effects dra matic relief of symptoms by *procaine injection* (p 2814) into indurated muscles sprained ankles tender nodules particularly in the low back and irritations of bursae such as in the subacromial region he is greatly con cerned with *congenital abnormalities* of the skeleton such as dislocation of the hip he cooperates in the treatment of infections involving the *neuro-muscular apparatus* he assists in the prevention of deformity in arthrop-athies and assumes a progressive attitude in reeducation and rehabilitation of involved muscles and joints

OPERATIVE ORTHOPEDICS

Operative orthopedics has expanded to great proportions The opera tive orthopedic surgeon is consulted for the *open reduction of fractures* for skin and skeletal *traction* for *amputations* for operations involving the *lengthening and transplantation of tendons* for *tenotomy* to divide a tendon *myotomy* to incise muscle or *capsulotomy* to free a joint He per forms *peripheral nerve resections neurolyses* and *nerve grafts* to modify or restore motor function His procedures include *synovectomy* and exci sion of the membranes of the joints as in the knee

In the deeper structures his repertory includes *arthrotomy* by which the joint i opened *arthrodesis* to obliterate a joint *arthroplasty* for the production of a new or false joint On bony structures he performs *osteoc lases* or *osteotomies* to divide or remove abnormalities of bone and *plas tic operations* to correct bone length He drains the medullary cavity in osteomyelitis and corrects structural and functional deformities of the foot

The majority of orthopedic operations are accompanied by surprisingly little shock and reaction despite the fact that the procedures may consume many hours on the operating table Those surgeons who entertain the be lief that speed of operation is of importance and that lengthsome anes

1 per cent procaine Insertion of the needle reproduces the subjective tenderness after which the injected anesthetic solution abolishes distress for many hours (p 2814)

METHODS OF TREATMENT

Operative and non operative treatments yield extraordinarily satisfactory results in many disturbances of the skeletal and locomotor systems The accessibility of most of the structures of support and locomotion allows

DIFFERENTIAL DIAGNOSIS OF

Increased or Abnormal Motility (Hypermotility) of Joints

Increased or abnormal joint motility is rarely encountered but its implications are usually of great significance

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Dislocation of Hip	Shortening of leg with abnormal range of motion Posterior displacement of head of femur Best revealed by x rays (p 2978) Refer to orthopedist.
Amaurotic Family Idiocy	Fatal disturbances of infancy Generalized hyperflexibility with blindness Cherry red spots in fundus (p 1333)
Ehlers Danlos Syndrome	Double-jointedness Usually associated with hyperelasticity of skin
Metabolic Disturbances	Rickets with epiphyseal deformities Therapeutic response to vitamin D and calcium (p 2850)
Trauma	With dislocation or subluxation In knee due to rupture of cruciate ligaments (p 2962) Often associated with fracture of tibial spine (p 3045) Get x rays and refer to orthopedist
Neuropathies	Charcot joint in tabes dorsalis and syringomyelia (p 1464) Get x rays Note sensory dissociation in syringomyelia (p 1505) Positive Wassermann and tabetic gold curve of spinal fluid in cerebrospinal syphilis

exercise (p 3757) massage (p 3766) the application of heat and cold (p 3787) and the use of methods of injection and aspiration (p 3769)

Orthopedic surgery has reached a phenomenal peak of efficiency in the last decades The successful introduction of bone technic has robbed operations on bones and joints of the horrors of infection Prolonged and formidable procedures involving the most amazing feats of reconstruction can be performed on the skeleton with relatively little risk and almost no shock The technical details of the more important operative measures are given elsewhere (p 2809)

Osteo-arthrosis	Metabolic disturbance usually in obese middle-aged patients with hypometabolism. Involvement of spine weight bearing and distal interphalangeal joints. X rays show narrowed joint spaces lipping and spur formation (p 2855) Normal temperature and sedimentation rate No muscle atrophy Institute complete therapeutic routine (p 2802)
Myxedema	With low B.M.R. and therapeutic response to thyroid extract.
Infections and Inflammations	
Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylococcemia meningococcemia gonococcemia brucellosis tuberculosis and mycoses Look for pathogen (p 2910) Try anti infective treatment (p 106)
Bursitis	Inflammatory swellings of peri articular bursae most frequent in shoulder elbow and knee Joint may be uninvolved. Consider aspiration (p 2904) injection of procaine (p 2807) and surgical intervention.
Fibromyositis	Non suppurative inflammatory process involving soft supportive tissues Most frequent in shoulder back and feet Partial or complete *ankylosis but normal radiographs (p. 2894)* Try physiotherapy and injections of procaine (p 2807)
Pyarthrosis	Purulent effusion due to local or systemic infection. Consider aspiration for identification of pathogen (p 2905) Try anti infective treatment (p 106) and consider surgical intervention.
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young *adults Involvements* of any and all joints especially spine and proximal interphalangeal Note pyrexia, increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine (p 2925)
Myopathies	Myositis ossificans with calcific deposits in x rays of muscles (p 2879) With atrophy and rupture of muscle or *tendons*

thesia unfavorably influences the patient should carefully observe the orthopedic patient who usually suffers little *discomfort or reaction after* several hours of severe mauling

Skin Traction —Skin traction is used in oblique fractures or those in which the mass of soft tissue surrounding the bone obviates the use of plaster Skin traction *is applied by painting the area with adherent liquid* or tincture of benzoin A length of moleskin is applied extending in leg fractures from slightly below the knee to approximately 6 inches below the heel The lower free end of the moleskin is attached to a spreader to which the traction is applied

Skeletal Traction —Skeletal traction requires the drilling of bone by such

DIFFERENTIAL DIAGNOSIS OF

Diminished Motility of the Joint, Locking, and Ankylosis

Impaired joint motility is incapacitating whether it involves a larger joint or smaller articular surfaces of fingers and toes Investigation is facilitated by radiography and the ease with which joint fluid may be aspirated.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Arthrogryposis Multiplex Congenita	Rare anomaly involving many joints Usually associated with talipes (p 2834)
Klippel Feil Syndrome	Ankylosis of upper cervical vertebrae With shortening of neck (p 2817)
Talipes	Frequent anomaly Recognized by deformities of extremities (p 2831) Refer to orthopedist.
Mechanical Disturbances	
Contractures	Dupuytren s syndrome of palmar fascia of fingers (p 2897) Volkmann s contractures following burns or ischemia (p 3025)
Epiphyseal Disturbances	Aseptic necrosis of growing epiphyses in children and adolescents. Produces Scheuermann s kyphosis Legg-Calve-Perthes disease of hip Osgood-Schlatter disease of knee Freiberg disease of metatarsals Kohler s disease of tarsal scaphoid and Kienbock s disease in carpal semilunar Get x rays and refer to orthopedist (p 2927)
Fractures and Dislocations	History of trauma Local pain, tenderness crepitus and false point of motion. Get x rays and refer to orthopedist.
Hemarthrosis	Bloody effusion usually due to significant trauma Repetitions or bleeding from slight injury suggest hemorrhagic diathe es particularly hemophilia (p 1118) Check hemogram and bleeding and coagulation times get Wassermann.
Hydrarthrosis	Swelling of joint due to outpouring of serum. May be idiopathic as in intermittent type or due to allergy or trauma Consider aspiration (p 2801) Check smears and cultures (p 50)
Tear of Semilunar Cartilage of Knee	Traumatic with locking if cartilaginous fragments are loose (joint mice) May terminate in osteochondritis dissecans (p 2962) Get x rays and refer to orthopedist
Surgical	Following arthrodesis
Metabolic Disturbances	
Allergic Arthropathies	With effusion Often associated with serum sickness (p 548)
Gout	Metabolic disorder of purin metabolism Note high blood uric acid tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine (p 2874)

grafts are highly specialized procedures which attempt to modify or re store the voluntary motor nerve supply to an involved muscle or group of muscles They should not be attempted by the practitioner

Synovectomy.—Synovectomy is a surgical excision of the synovial mem brane of a joint It is most frequently used in cases of isolated boggy syno vitis of nonspecific etiology resistant to conservative therapy The joint capsule is excised almost completely There is remarkably little interfer ence with subsequent joint function and a new synovial membrane is soon formed

Arthrotomy.—An arthrotomy is an operation which opens into the joint It is used for example to remove from the knee torn or displaced cartil age a foreign body or a loose particle of bone (joint mouse)

Arthrodesis.—Joints irreparably damaged by tuberculosis long existing arthritis or trauma are usually so poor in function and so painful that the patient is improved by arthrodesis an operation designed to obliterate the joint Pain is alleviated and disability is minimized if the joint is fixed in the position which is most advantageous to the patient in his occupation or diversion

The usual position of fixation for the elbow is at about 90 degrees of flexion The wrist should be fixed in slight dorsiflexion the knee in about 15 degrees of flexion the hip in about 30 degrees of flexion with neutral rotation and abduction However if the patient is going to do a great deal of sitting it may be desired to have his knee and hip fused in more flexion An individual engaged in manual labor frequently will prefer more extension at the elbow

Arthrodesis of the spine is a spine fusion Here only the posterior por tion of the spinal laminae are fused but this is sufficient to immobilize the entire vertebrae

Arthroplasty.—Occasionally a joint will be fused or almost ankylosed by disease which has subsequently become quiescent Upon occasions it will be found desirable to restore motion by reestablishing the joint The operation of arthroplasty consists in dividing the bone and interposing some substance to prevent union while early motion is encouraged In other words a non union of the surgically induced fracture is desired The bone ends are modeled to correspond roughly to the joint surfaces and the substance interposed is often fascia lata obtained from the patient or vitallium cups may be used for interposition material It must be borne in mind that this operation upon a solidly fused joint exchanges stability and freedom from pain for some degree of motion and possible return of pain and instability This may not be a fair trade in the case of a weight bearing joint whose owner must pursue a strenuous occupation hence the indications must be carefully selected

Bone block.—Operations to limit joint motion are indicated principally in the flail joint of poliomyelitis The joint range may be limited by sur gically raising an excrescence of bone on or near one articular surface to act as a bone block The most popular example of this type of procedure is the posterior bone block of the paralyzed ankle to prevent drop foot An anterior bone block may be used to prevent recurvatum at the knee

Tenodesis.—Tenodesis achieves the same end as the bone-block by forming a check ligament from the tendon of one of the muscles acting on

means as a Kirschner wire To the ends of the metal traction is applied by the specialist consultant

Amputation —In all *amputations* an effort is made to save as much of the extremity as possible This is particularly true of the hand where even a rigid or immovable stump of a thumb may still serve as a point against which the movable fingers may act to grasp an object Various types of cineplastic amputations and modifications of amputation stumps have been devised to permit active motion of the prosthesis in the upper extremity

In the lower extremities the optimum sites of amputation in the foot are at the metatarsophalangeal joints or through the shaft of the metatarsal Amputations which go through the region proximal to the attachment of the long tendons of the foot are unsatisfactory due to a tendency to subsequent equinus unless accompanied by arthrodesing operations at the ankle The Symes amputation which preserves the weight bearing function of the heel is extremely satisfactory Mid leg amputations which were previously considered to be the optimum level are now beginning to fall into the discard in favor of end bearing stumps at the heel or at the knee Indications for any particular case are the province of the orthopedist specialist

It is important for the practitioner to know that with most amputations below the knee the gait particularly if the individual is young will be almost indistinguishable from normal once a satisfactory prosthesis has been fitted Amputations above the level of the knee generally entail some degree of limp and disability which increases as the amputation becomes higher These latter amputations are not end bearing but take the weight of the superincumbent body upon the ischial tuberosity whence it is transmitted to the brace by an attached ischial ring

Tendon Lengthening —Contractures of muscles about joints which do not yield to gradual stretchings and physiotherapy require operative lengthening of their tendons A Z shaped cut is made in the tendon and the ends are slipped past each other until the deformity is corrected

Muscle and Tendon Transplantation —The transplantation of muscles and tendons is particularly valuable in poliomyelitis Where the quadriceps muscle has been completely paralyzed with resulting anteroposterior instability at the knee benefit may be derived from the transplanting of the biceps femoris insertion from the head of the fibula into the patella It is needless to say that this requires an active biceps as a prerequisite The patient learns to control this muscle independently of the other knee flexors and enough extensor power of the knee is usually acquired to control the instability Similar transplants may be done at the ankle using the peroneus longus to replace the paralyzed dorsiflexors In this operation only the insertion of the muscle is changed The muscle belly, its innervation and its blood supply remain intact

Tenotomy —Tenotomy is the surgical division of a tendon It is usually performed in the contractured heel cord of club foot

Myotomy —Myotomy is the surgical division of a contractured muscle most frequently the sternocleidomastoid in torticollis

Capsulotomy —Capsulotomy is the surgical division of a contractured portion of a joint capsule

Operations on Peripheral Nerves —Nerve resection neurolysis and nerve

is reached and the procaine is deposited into and around the tender spot Suction should always be made on the syringe to preclude injection into a blood vessel Following injection palpation should now demonstrate the absence of the previously marked tenderness and the joint or affected structure should be moved through its full range

Frequently the new tender spots masked by the original more tender zones become noted after the first point has been anesthetized These may require further injection

Curare—Under institutional conditions and observant of precautions elsewhere detailed (p 3888) injections of curare (intocostrin) are used by the orthopedic surgeon in the treatment of poliomyelitis and spasticity and in providing relaxation for the setting of a fracture or the reduction of a dislocation

the joint Thus a tenodesis of the achilles tendon may be used to prevent calcaneus deformity at the ankle The relationships obtained are permanent only if skeletal growth is completed

Transplant of Fascia Lata—Rarely a traumatic subluxation or dislocation in a normal limb is followed by residual instability The weakened ligament may be replaced or reinforced by autogenous fascia lata tendon or similar substance

Osteotomy and Osteoclasis—Osteotomies or osteoclases are attempted to correct alignment In the former an incision is made and the bone is divided by the use of instruments In the latter an incision is not made but the bone is manually broken leaving the skin intact In either case the alignment is then corrected and a period of immobilization in plaster follows until the bone is healed in its new position The operation is used in bowlegs and similar angular deformities of bone It is also of value in correcting joints which are ankylosed in poor position

Epiphyseodesis—Operations to correct bone length are employed for the extremity which is too long compared with its mate The longer limb is usually the well extremity, the opposite one having been shortened by poliomyelitis mal union of a fracture or epiphyseal disturbance If growth is not yet complete the growth rate of the longer extremity may be slowed by epiphyseodesis (surgical fusion) of one or more of the epiphyses so that the shorter extremity can catch up in length Tables of expected growth from each epiphysis have been prepared so that estimations may be fairly accurate When growth has ended an actual segment of bone is removed from the longer leg and the remaining ends are step cut to fit closely together They may also be overlapped and fixed in this position at the correct length and maintained in plaster of paris until union is complete

Leg Lengthening—Leg lengthening operations in which the short leg is lengthened are extremely complicated and difficult and generally are not indicated

Procaine Injections—Procaine injection is of value in a great many acute or chronic traumatic affections of the musculoskeletal system provided only that the lesion is well circumscribed and localized It diminishes pain and hastens recovery in nearly all sprains whether in the more accessible joints or associated with fascial injuries as occur in the low back It is also valuable in treating the fibrous nodules associated with fibrositis (p 2894) The use of procaine anesthesia for the reduction of fractures is elsewhere discussed (p 2982)

The exact mode of action of procaine in these conditions is not well understood It is thought by some that procaine acts to break the vicious cycle of pain spasm pain Whatever the modus operandi the results attending its use are often gratifying

Up to 20 cc of 2 per cent procaine or up to 40 or 50 cc of 1 per cent procaine may be used safely at one sitting in the case of an adult It is advisable to administer 1½ grains of some rapidly acting barbiturate such as nembutal or seconal one half hour before the injection is given Under aseptic precautions a preliminary skin wheal is raised directly above the tender spot which has previously been marked off after careful palpation A small bore needle is then inserted directly down until the tender spot

opposite side there is often an associated *facial asymmetry* which progresses as the deformity persists and regresses if the deformity is corrected at an early age If the deformity is not corrected until growth is complete facial asymmetry is permanent

Treatment—Mild examples of wry neck are corrected by systematic *stretching* of the shortened muscle In most instances however *myotomy* of the affected muscle is effected by the orthopedist consultant The post operative care entails *exercises* and manual training after the second day



Fig 0 —Congenital torticollis (wry neck)

SYNOSTOSIS OF THE CERVICAL SPINE (KLIPPEL-FEIL SYNDROME)

In this condition all or only the lower cervical vertebrae are fused into one homogeneous structure producing an abnormal *shortness of the neck* with restriction of motion in all directions Congenital synostosis is usually associated with spina bifida Roentgenograms *depict* the characteristic changes

There is no method of treatment for this condition at the present time

CERVICAL RIB

Cervical rib represents an incorporation of the seventh cervical vertebra into the thoracic group The rib is usually rudimentary and rarely exceeds 5 cm in length It may be unilateral or bilateral

CHAPTER 131

THE SKELETAL AND LOCOMOTOR SYSTEMS CONGENITAL ABNORMALITIES

CONGENITAL abnormalities of the structures of support and locomotion are encountered with great frequency Anomalies consist of *defects* or absences the presence of *supernumerary parts asymmetries fractures dislocations failure to fuse* or *ankylosis* between normally moving parts The congenital anomaly is usually recognized at birth but congenital dislocation of the hip may not become apparent until the child begins to walk Derangements such as *spina bifida occulta* may never be discernible or may be discovered only as chance radiographic findings The clinical importance of congenital lesions varies widely *spina bifida occulta* (p 2870) is usually asymptomatic whereas *congenital talipes* (p 2831) if uncorrected handicaps the sufferer throughout life

It is the function of the practitioner to examine newborn infants and young children for evidences of congenital abnormality Oftentimes congenital dislocation of the hip is not apparent unless its possible presence is suspected and sought roentgenograms are of great value in definitely establishing the diagnosis

In the presence of a congenital abnormality the practitioner evaluates its *functional importance* both present and future Conditions which will later interfere with the free use of hands and legs should be referred promptly to the orthopedic surgeon relatively minor procedures expertly performed in early life prevent needless physical disability as well as social economic and psychologic handicaps that go with any infirmity

TORTICOLLIS (WRY NECK)

Congenital torticollis is a rotation and flexion deformity of the neck that results from a congenital abnormality of the cervical spine (*e g* hemivertebra) or a contracture of one of the *sternocleidomastoid muscles* injured during delivery In the latter instance the damaged structure is palpable as a fusiform cord which approximates the mastoid process of the affected side towards the sternoclavicular joint the neck is deviated laterally toward the affected side and the chin is twisted toward the

opposite side there is often an associated *facial asymmetry* which progresses as the deformity persists and regresses if the deformity is corrected *at an early age* If the deformity is not corrected until growth is complete facial asymmetry is permanent

Treatment —Mild examples of wry neck are corrected by systematic *stretching* of the shortened muscle In most instances however *myotomy of the affected muscle is effected by the orthopedist consultant* The post operative care entails exercises and manual training after the second day



Fig "0 —Congenital tort coll s (wry neck)

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There is no method of treatment for this condition at the present time

CERVICAL RIB

Cervical rib represents an incorporation of the seventh cervical vertebra into the thoracic group The rib is usually rudimentary and rarely exceeds 5 cm in length It may be unilateral or bilateral

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Cervical Spine

The diagnosis of disturbances of the cervical spine is complicated by the fact that so wide a variety of important glandular re piratory nervous and vascular structures is concentrated within the confines of a relatively small surface area Skeletal and muscular deformities are encountered infrequently but they usually connote disturbances of profound and important significance

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Klippel Feil Syndrome	Synostosis of cervical spine with local ankylosis and shortness of neck (p 2817)
Torticollis	Wry neck. Relief from simple surgical procedures (p 2816)
Trauma	
Fractures and Dislocations	Demonstrable by x ray Consult specialist.
Subluxation of Interarticular Facets	Crick in neck. Reduced by manipulation (p 2968) Check lateral oblique films (p 3006)
Psychogenic	Hysterical contractures (p 1367)
Infectious and Inflammatory	
Fibromyositis	With normal x rays Seek nodular tender areas. Alleviated by injections of procaine (p 2894)
Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylococcemia meningococcemia, gonococcemia brucellosis tuberculosis or mycoses. Look for *pathogen (p 2905) Try anti infective treat*ment (p 106)
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults. Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine (p 2925)
Syphilitic Osteochondritis	Positive Wassermann. Therapeutic response to penicillin (p 2938)
Tuberculosis	Note acid fast lesions elsewhere and demonstrable x ray changes (p 2944)
Metabolic Disturbances	
Osteo-arthrosis	Metabolic disturbance usually in obese middle aged patients with hypometabolism. Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine (p 2862)
Osteoporosis	In elderly patients with bowing bone atrophy *and local pain (p 2517)*
Reticulo-endothelioses	Note cutaneous xanthoma deformities of skull or splenomegaly (p 1133)

Cervical rib is usually an unimportant and chance finding and is productive of no discomfort If it exceeds 5 cm in length however it may displace the subclavian artery and/or the brachial plexus producing pressure symptoms *such as neuritic manifestations with pain* along the ulnar side of arm and forearm In the more severe instances there is progressive *paresis* and *wasting of the intrinsic hand muscles* Arterial occlusion on rare occasions is sufficient to obliterate the pulsation at the wrist and interfere with the nutrition and function of the arm

In the absence of a demonstrable cervical rib an identical syndrome results from tightness or spasm of the *scalenus anticus muscle* (p 2953)

Treatment—Unless there are neuritic or vascular symptoms cervical rib requires no treatment With brachial neuritis or evidence of compression of the subclavian artery the patient is referred to the orthopedic surgeon for removal of the rudimentary structure or division of the scalenus anticus muscle



Fig 703—Cervical rib on the left side (Andrews)

TRANSITIONAL VERTEBRA

The course of evolution tends toward the development of fewer lumbar vertebrae with incorporation of the fifth lumbar vertebra into the sacrum Sacralization of the fifth lumbar vertebra is evidence of this evolutionary trend

Sacralization of the fifth lumbar vertebra rarely produces symptoms If the ala of the transitional vertebra impinges upon the ilium an *adventitious joint* is formed This becomes the seat of an osteo arthrosis and produces *back pain* At times the discomfort *is* on the side opposite to the impingement *and is* due to strain on the ligaments from the unusual mechanical arrangement

The diagnosis of sacralization is made only with certainty by the roentgenogram In the presence of pain or discomfort *treatment* is similar to that for any other type of back disability (p 3072)

HEMIVERTEBRA

Hemivertebra is a rare congenital condition in which only one lateral half of a vertebral body is present As a result the spine angulates toward the deficit side The resulting *scoliosis* (p 3060) is resistant to treatment and requires the attention of the specialist

TROPISM

Tropism is a term applied to a variation in the inclination of the *posterior articular facets* of the vertebrae Normally these facets are symmetrical though the inclination varies with the vertebra Tropism favors the possibility of *subluxation* or *dislocation* The incongruous joint surface also imposes an unusual strain upon investing ligaments



Fig 704 —Congenital anomaly of last lumbar vertebra Note unilateral sacralization of transverse process (Drawing from roentgenogram)*

Tropism is noted on the anteroposterior or three quarter lateral roentgenogram The condition is suspected in individuals who suffer from recurring episodes of *acute back strain* The patient is entitled to consultation with the specialist orthopedist Exploration of the region may reveal abnormal mobility fusion yields brilliant operative results

SPINA BIFIDA

Spina bifida is the commonest example of congenital failure of fusion In the presence of this defect one or more vertebral arches usually in the lumbar region are deficient Through the gap the contents of the spinal cord may be protruded If there is no external evidence of herniation of the soft tissues the condition is a *spina bifida occulta* *spina bifida mani*

* Shands Handbook of Orthopaedic Surgery C V Mosby Company

testa or vera occurs when there is an obvious soft tissue tumor containing subcutaneous structures and at times meninges and their contents

Clinical Manifestations—In the majority of instances spina bifida occulta produces no symptoms Demonstration of the abnormality in the presence of back pain is not sufficient to warrant the inference that the organic disorder produces the clinical disturbance However the presence of spina bifida predisposes to attacks of *low back sprain* due to absence of the firm ligamentous anchor that is afforded by the missing spinous process

Spina bifida may produce neurologic manifestations such as *flaccid* or *spastic paralysis* and *incontinence of urine* or *stool* it is often associated with *clawfoot* (p 3087)

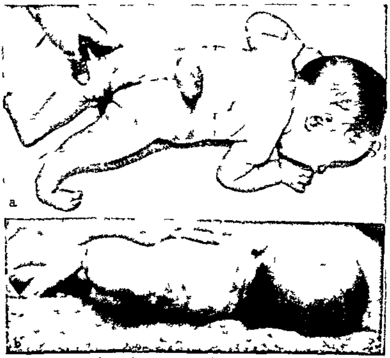


Fig 0 —Mening cel with associated malformations *a* Lumbar spina b fida with myelomen n oc l a d no paralyt c lub-feet *b* lumbosacral spina bifida th myelomeningocele and hydrocephalus

Diagnosis—The presence of spina bifida manifesta is obvious on inspection Spina bifida occulta is suspected if there is a local *hypertrichosis* and *pigmentation* of the skin or a dimple which overlies the bony defect A positive opinion can be given only after viewing the roentgenograms

Treatment—In the presence of positive demonstrable symptoms the patient with spina bifida should be referred to the orthopedic or neurologic surgeon Spina bifida manifesta *requires immediate attention* since neurologic manifestations will almost inevitably occur and the unprotected meninges invite infection

Cone in Christopher A Textbook of Surgery

DIFFERENTIAL DIAGNOSIS OF

Swellings of the Back

The swelling that is encountered along the region of the spine warrants intensive investigation Under no circumstances should diagnostic aspiration be attempted since the enlargement may be due to protrusion of meninges or cord and there is the hazard of the introduction of infection

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Neoplasm	Lipoma
Spina Bifida	Congenital failure of fusion of laminae of vertebrae May be occulta and detected only by x ray (p 2820) Manifesta productive of localized tumor between occiput and sacrum May contain meninges (meningocele) brain (encephalocele) or spinal cord (myelocele) Refer to consultant surgeon in presence of neurologic disturbances
Tuberculous Osteomyelitis	Destruction of vertebral bodies with kyphosis (gibbous) Formation of cold abscess (Pott) Neurologic signs due to cord compression (p 2942) Refer to orthopedic consultant
Chronic Nontuberculous Osteomyelitis	Usually pyogenic with destruction of bone. Abscess formation in soft tissues (p 2936) Refer to consultant orthopedist for exploration and treatment
Fibromyositis	Nonsuppurative inflammatory process involving connective tissue Normal x rays multiple isolated areas of pain, tenderness and nodule formation (p 2894) Note effects of procaine injections into trigger points (p 2807)
Perinephric Abscess	In lumbar region Due to suppuration of capsule of kidney Note obliteration of psoas shadow on x ray (p 2360) Refer to urologist for diagnostic aspiration and surgical exploration
Renal Neoplasm	In lumbar region, particularly in children. Usually a malignant Wilm s tumor (p 2327) Refer to urologist for nephrectomy and/or radiation therapy

PARTIAL ABSENCE OF THE RADIUS (CLUBHAND)

Partial absence of the radius is most often observed at the distal end As a result a clubhand is nearly always associated with the deformity The hand may be in the flexed extended adducted or abducted position The *commonest type* is abduction or radial deviation associated with a small or completely absent thumb

Treatment —The treatment of clubhand is attempted by expert manipulation If correction is accomplished the limb is immobilized in plaster Should the procedure fail the consultant should attempt an operative correction with bone grafts

The handicap of the *absent thumb* is so great as to demand an immediate attempt to reconstruct the missing digit Remarkable successes

in the treatment of this condition have been accomplished by orthopedic surgeons

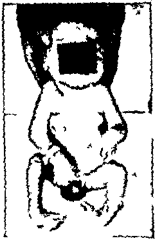


Fig. 906.—Arthrogryposis multiplex congenita or club-hands, club-feet and multiple contractures



Fig. 907.—Sprengel's deformity Showing the inability to raise the arm completely on the affected side †

ELEVATION OF THE SCAPULA (SPRENGEL'S DEFORMITY)

Sprengel's deformity is congenital elevation of the scapula In itself it is of no clinical significance except that it is usually associated with other

* Van Derwerker in Christopher A Textbook of Surgery
† Griffith and Mitchell Textbook of Pediatrics

congenital anomalies such as defective development of the cervical vertebrae or an associated torticollis

Sprengel s deformity is often accompanied by a tight band leading from the scapula to the adjacent spinous processes of the vertebrae If the deformity is severe and there is local pain this may be divided with relief of symptoms

CLEIDOCRANIAL DYSOSTOSIS

Congenital absence of both clavicles (*cleidocranial dysostosis*) *in itself* is of no importance It is usually associated however with congenital changes in the skull The condition is rare and is readily recognized by

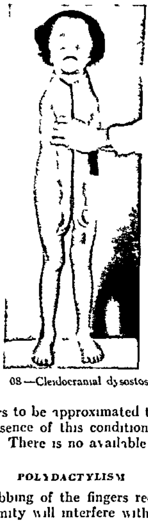


Fig 08—Cleidocranial dysostosis *

the ability of the shoulders to be approximated to each other in the front of the thorax In the presence of this condition other congenital abnormalities should be sought There is no available treatment

POLYDACTYLISM

Polydactylism and webbing of the fingers require no attention unless it appears that the deformity will interfere with the use of the hand for fine movements If this suspicion is entertained an expert in reconstructive surgery should be consulted since it is possible to achieve extraordinary operative results

Before the supernumerary digit is amputated the practitioner should assure himself that there will result no important impairment of function

* Caldwell in Pullen Medical Diagnosis

Occasionally the digit which seems to be abnormal has better tendons and motor power than the one which seemingly occupies a normal position

COXA VARA

Coxa vara is a mechanical abnormality of the upper end of the femur It consists of a decrease in the angle of shaft with neck and an associated anteversion of the neck resulting in shortening of the extremity and weakening of abductor power While coxa vara is usually congenital the deformity may be acquired secondary to fracture a slipped epiphysis or rickets

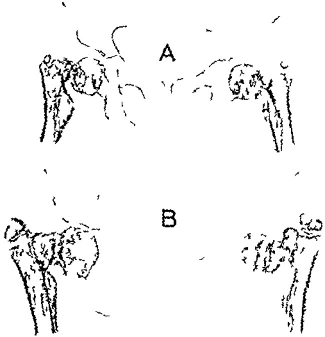


Fig 709—*A* Bilateral congenital coxa vara Patient aged four years *B* Bilateral congenital coxa vara in same patient at twelve years. (Drawing from roentgenograms)

Symptoms and Diagnosis—Congenital coxa vara generally causes no signs until the child begins to walk Even at this time the child may not complain of weakness or stiffness in the extremity However if attention is called to the hip by a *slight limp* physical examination will reveal a prominence and elevation of the greater trochanter

In *unilateral lesions* there may be shortening of the extremity of varying degrees With *bilateral lesions* there appears a characteristic gait which resembles the duck waddle seen with the congenital dislocation of the hip All of these signs are variable and depend upon the degree of coxa vara which may be very slight or very marked

Positive diagnosis requires an x ray which reveals a decrease in the

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DIFFERENTIAL DIAGNOSIS OF

Painless Swellings and Deformities Involving Hips, Thighs, Calves and Legs (Exclusive of Feet and Toes)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies

Coxa Vara (Plana) — Congenital disturbance Shortening of leg due to decrease in angle made by shaft of femur with neck (p 2825) Obtain x rays Refer to consultant orthopedist for therapy

Dislocation of Hip — Posterior displacement of head of femur Diagnose before period of weight bearing by shortening of leg x ray changes and abnormal mobility of hip (p 2828) Refer to consultant orthopedist

Talipes — Visible manifestations of club-foot (p 2831) Refer to consultant orthopedist

Psychogenic — Hysterical contractures (p 1367)

Neurogenic — Atrophy following lesions involving lower cords lumbosacral plexus or peripheral nerves Make complete neurologic examination with particular reference to motor and sensory changes Consult with neurologist and neurosurgeon

Trauma — Mal union of fractures and irreducible dis locations Refer to consultant orthopedist

Neoplasms

Solitary Bone Cyst — Expanding benign lesion of long bones May cause pathologic fracture Obtain biopsy (p 2839) and refer to consultant

Giant-cell Tumor — Benign neoplasms of epiphyseal ends of long bones. X rays show multiloculated areas with thinned but unbroken cortex (p 2840) Refer to orthopedist for biopsy and treatment.

Ganglion — Soft tissue tumors usually in vicinity of wrist (p 2902) Rupture by pressure or refer to surgeon for excision

Osteogenic Sarcoma — Primary malignancy usually about knee often associated with pain swelling and fever (p 2843) Get x rays Refer to consultant orthopedist for biopsy and treatment

Disturbances of Epiphyses

Legg Calvé Perthes Disease — Epiphyseal disorder in children with anterior pituitary type of obesity and hypogonadism (p 2927) X rays reveal density of epiphyses and atrophy of neighboring bone Refer to specialist consultant

Osgood Schlatter s Disease — Epiphyseal disturbances of knee as above (p 2929) Refer to specialist consultant

Slipped Epiphysis — Of head of femur Get three dimensional x rays (p 3043) Refer to orthopedist

CONTINUED

Syphilitic Osteochondritis	Charcot joint with absent reflexes and fixed pupils Tabetic gold curve in cerebrospinal fluid (p 2938)
Tertiary Syphilis	Gummas Therapeutic response to iodide
Myopathies	Weakness with hypertrophy or atrophy resulting from muscle dystrophies (p 2882)

angle between the neck and the shaft Lateral views demonstrate the anteversion of the neck if present

Treatment—The treatment of coxa vara is the province of the orthopedic specialist Conservative management is used in milder cases This failing *osteotomy* is attempted to realign neck and shaft

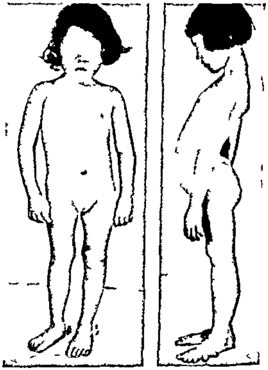


Fig 710—Bilateral congenital dislocation of the hip

DISLOCATIONS OF THE HIP

In congenital dislocation of the hip the head of the femur is displaced posteriorly at birth When the child begins to walk weight bearing causes the head to ride up the side of the pelvis and make a false acetabulum As growth progresses distorted mechanical stresses produce abnormal conformation of the femoral head If this is allowed to continue for some period of time the head is very greatly distorted and cannot be reduced

Congenital dislocation of the hip is more frequently seen in the Mediterranean races particularly in children of Italian ancestry

Diagnosis—Congenital dislocation of the hip is suspected when there is

* Caldwell in Pullen Medical Diagnosis

a difference in the creases on the inner side of the thigh just below the buttock The diagnosis can be made and should be made before the child has walked The *affected leg is shorter* as demonstrated by placing the child on its back and flexing both hips to 60 degrees while the soles remain on the table Under these circumstances a definite difference in the height of the knees is demonstrable Again the head of the femur may be felt out of the socket The projecting mass is then palpable in the buttock

The sign known as *telescoping is elicited by grasping the pelvis firmly* in one hand and the knee of the suspected extremity in the other Alternate compression and traction made along the long axis of the femur reveals abnormal mobility



Fig 711 —Unilateral congenital dislocation of the hip

Congenital shallow acetabulum may occur alone without dislocation of the femur It may be symptomless until the development of a premature osteo arthrosis in later life

When the child has begun to walk additional evidence of the disturbance is afforded by the *limp* of the affected side *Pain* does not usually occur until later in life *when arthritic changes have become evident in* the deformed hip joint

The presence of a congenital dislocation is strongly suspected when *there is a positive Trendelenburg sign* Normally when a patient stands upon one extremity and raises the other foot from the floor the pelvis is tilted with its higher side on the side of the elevated foot If the abductors on the side of the weight bearing extremity are weak the side of the pelvis

Caldwell in Fullen Medical Diagnosis

on the side of the elevated extremity drops below the level of the side on which the patient is standing

The diagnosis is definitely demonstrable by *x ray* of the hip the opposite joint being filmed for comparison See *Hip Disturbances of* (p 3038)

Treatment—When the head of the femur and the acetabulum are as yet relatively undeformed *conservative treatment* affords splendid results Hence the importance of early diagnosis cannot be overemphasized The child is referred to the orthopedic specialist who effects *closed reduction* and then applies a *plaster spica*

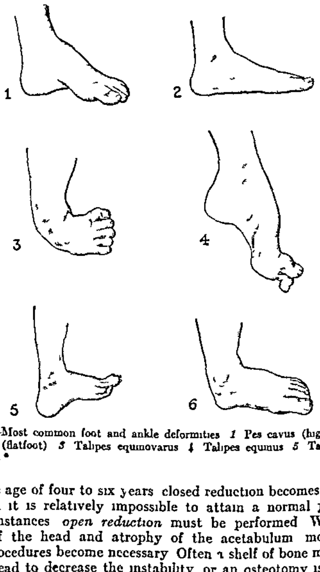


Fig 712—Most common foot and ankle deformities *1* Pes cavus (high arched foot) *2* Pes planus (flatfoot) *3* Talipes equinovarus *4* Talipes equinus *5* Talipes calcaneus *6* Ankle valgus *

After the age of four to six years closed reduction becomes increasingly difficult and it is relatively impossible to attain a normal joint Under these circumstances *open reduction* must be performed With marked distortion of the head and atrophy of the acetabulum more intricate operative procedures become necessary Often a shelf of bone must be built above the head to decrease the instability or an osteotomy is effected to change the thrust of weight bearing With the more complicated operations the risk is greater and the possibility of a satisfactory result more remote

* Lewin The Foot and Ankle Lea & Febiger Publishers

TALIPES (CLUBFOOT)

Congenital talipes literally denotes an abnormality in which the patient walks on the ankle The four cardinal positions are *equinus* or plantar flexion *calcaneus* or dorsiflexion *varus* or inversion and *valgus* or eversion The most frequently encountered variety is *talipes equinovarus* in which the foot is turned in inversion the shortening of the heel cord producing additionally an equinus deformity

Talipes equinovarus may be unilateral or bilateral The deformity may vary in degree from one that is very mild to the most severe in which there is adduction of the forefoot upon the hindfoot the toes being turned in until they virtually touch the tibia Other talipes deformities include calcaneovalgus equinovalgus and calcaneovarus the last being observed infrequently

Occurrence —Talipes equinovarus is the *commonest* congenital abnormality of the foot It constitutes 75 per cent of all malformations and occurs once in each thousand births It is seen twice as frequently in boys and in 10 to 15 per cent of instances there is a family history of a similar disturbance

Diagnosis.—Congenital clubfoot is easily recognized at birth The patient should be referred promptly to the consultant surgeon since *early treatment* is highly satisfactory Deferred therapy of the neglected club *foot is extremely arduous* and may require operative intervention Roentgenograms of the foot disclosing the abnormal relationship of the tarsal bones are of value in determining the relative completeness of manipulative treatment

Treatment —The management of early talipes is quite satisfactorily effected by *progressive manipulation* and *stretching* toward the corrected position Between stretchings correction is maintained by *immobilization* in plaster Treatment must be continued over a period of months and the foot must then be observed at intervals for several years thereafter since recurrences may be experienced when the overcorrection has not been complete Most recently the *Denis Browne splint* has replaced plaster treatment with great succe s The child stretches the feet by continued kicking in an appliance in which the feet are strapped to a bar

In older patients who have not had the advantage of early treatment the bones become misshapen as the result of misuse and deformity Manipulation alone will not produce the desired results *Operative correction* of the bone deformity is necessary following which the mobility of the tarsal joints is lost and the gait suffers accordingly

CONGENITAL FRACTURES

The majority of fractures in the newborn are due to *birth trauma* and are not associated with congenital defects They heal rapidly in a very short time Very little deformity occurs due to the extensive remodeling of the growing bone

Congenital fractures may be associated with defects or partial absences of bone particularly in the tibia They are resistant to treatment and may need bone grafting for satisfactory union (congenital pseudo arthrosis of the tibia)

DIFFERENTIAL DIAGNOSIS OF

Limp

The usual causes for transitory limp include poor shoeing foreign bodies within the sho or soft tissue injuries The problem of the persistent limp is of greater significance and its elucidation requires meticulous examination.

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies

Coxa Vara (Plana) — Leg shortening due to decrease in angle of shaft with neck and anteversion of neck of femur (p 2825) Get x rays and refer to orthopedist for consultation

Dislocation of Hip — Leg shortening due to posterior displacement of head of femur Note abnormal mobility of joint X ray Refer to orthopedic specialist

Metabolic Disturbances

Gout — Metabolic disorder of purine metabolism Note high blood uric acid, tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine (p 2874)

Osteo arthrosis — Metabolic disturbance usually in obese mid dle aged patients with hypometabolism In volvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation. Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute com plete therapeutic routine (p 2862)

Trauma and Mechanical Disturbances — Rupture of quadriceps extensor or plantaris Fractures and dislocations Hematomas in volving muscle or periosteum Shortening of Achilles tendon or leg Ingrown toenails Bunions Bad shoeing Weak foot Metatar salgia Dermatophytosis and other cutaneous afflictions (p 3099, Friction burns and blisters

Epiphyseal Disturbances

Legg Calve Perthes Disease — In children with adiposogenital syndrome Note lim tation of motion. Aseptic necrosis of capital epiphysis of femur produces dense x ray appearance in contrast to neighboring atropic bone (p 2927)

Slipping of Upper Femoral Epiphy is — In adolescence Get lateral x rays of head of femur (p 3043)

Osgood Schlatter s Disease — Involving epiphysis of upper end of tibia (p 2929) Get x rays and refer to orthopedic pecialist.

Psychogenic — Malingering Hysteria (p 1367)

Neurogenic — Spastic de ormities in cerebral palsy (scissors gait) (p 1455) Atrophic paralysis in polio myelitis (flail leg) (p 457) Hemiplegia with side-wheel swing (p. 1439)

NUED

Infections and Inflammations

Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylococcemia meningococcemia, gonococcemia brucellosis tuberculosis or mycoses Look for pathogen (p 2905) Try anti infective treatment (p 106)
Poliomyelitis	With muscle atrophy (p 457)
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor irritability (p 2910) Institute complete therapeutic routine (p 2925)
Tuberculous Arthritis	Usually involving hip or knee Other evidences of acid fast invasion (p 2942) Get x rays and refer to orthopedic specialist.
Syphilitic Osteochondritis	Particularly in neonatal syphilis (p 2787) Positive Wassermann of child s or mother s blood. Try intensive penicillin treatment (p 340)
Tertiary Syphilis	With gumma formation Therapeutic response to iodide

See also —Abnormalities of Gait (p 349b)



Fig 13 —Arthrogryposis

Caldwell in Pullen Medical Diagnosis

PES VALGOPLANUS

See p 3085

HEMIHYPERTROPHY AND HEMIATROPHY

Occasionally, one side of the body or perhaps one extremity will appear enlarged or shrunken in comparison with the opposite side This may include a difference in length as well as girth The differences in size may increase as the child grows

The origin of this disturbance is obscure and there is no available treatment at the present time

ARTHROGRYPOSIS MULTIPLEX CONGENITA

Arthrogryposis multiplex congenita is a peculiar type of *congenital deformity* of many joints Its origin is obscure and the treatment is difficult

CHAPTER 132

THE SKELETAL AND LOCOMOTOR SYSTEMS NEOPLASMS

- Benign Tumors
  - Osteomas
  - Osteochondromas
  - Chondromas
  - Bone Cysts
  - Giant-cell Tumors
  - Osteoid Osteomas
  - **Glomus Tumors (p 1135)**
  - **Neurofibromas (p 1415)**
  - Non-osteogenic Fibromas
  - Fibrous Dysplasia
  - Synoviomas
  - Eosinophilic Granulomas
- Malignant Tumors
  - Osteogenic Sarcomas
  - Endothelial Myelomas (Ewing)
  - Multiple Myelomas
  - Metastatic Carcinomas

THE most important neoplasms of the skeletal and locomotor systems are bone tumors which are rare but potentially dangerous Their recognition and differentiation are difficult and require consultation with the orthopedic surgeon Even under the microscope bone sections are not easy to interpret and they should be reviewed by an experienced pathologist

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of skeletal neoplasms is indicated in Table 150

OSTEOMAS

The osteoma is a benign tumor composed chiefly of almost normal bone of periosteal origin Osteomas arise in sites not subjected to irritation as on the skull X *rays* reveal a simple localized mound like thickening in the bone which is smooth and regular On microscopic inspection the tissue is almost indistinguishable from normal cortical bone The osteoma is to be differentiated from the *exostosis* which is a similar formation due to chronic local irritation

Treatment consists of local excision Recurrences do not occur unless persistence of irritation produces exostosis

OSTEOCHONDROMAS

The osteochondroma is a benign mixed tumor containing *cartilage* and *bone* It usually occurs in young persons between the ages of ten and twenty five years as an outgrowth from the shaft of the bone it is covered by a cap of cartilage from which the tumor itself grows by endochondral ossification It usually continues growing until cessation of the growth of the individual suggesting that it arises from an inclusion of parts of the epiphyseal line in the diaphysis

When the osteochondroma is small and not subject to trauma it usually produces no symptoms Enlarged tumors or those which are beneath an area that is subject to pressure may be the site of *pain* which is usually due to compression of the overlying soft tissue or inflammation of the bursa which forms over these tumors

X rays reveal an osseous mass of normal bone density that springs

TABLE 150 —DIFFERENTIAL DIAGNOSIS OF SKELETAL TUMORS

	Age	Site	Pain	Constitutional Symptoms	X ray	Pathologic Fracture
O teoma	Any	Skull cortex	None	None	Smooth regul ir	No
Osteochondroma	10–2ɔ yrs	Near end of shaft	Mild	None	Smooth stalk normal bone	No
Chondroma	Any	Shaft hands and feet	None	None	Area of diminished density in shaft	Yes
Bone cyst	Adolescence early adult life	Ends of femur humerus or tibia	None	None	Area of diminished density with sharp edges and thinned cortex	Yes
Giant cell tumor	*Adolescence early adult* life	Epiphyseal end of long bone	Mild	None	Multilocular expanded area	Yes
Osteoid osteoma	Any	Usually cortex	Severe	None	Centr l area of diminished density and zone of sclerosis	No
Osteogenic sarcoma	10–16 yrs	Fnds of shafts of long bones	Severe	Mild	Destruction of cortex with sun ray appearance	Yes
Endothelial myeloma	10–16 yrs	Long bones mid shaft	Severe	Moderate	Onion peel area around central destruction	Yes
Multiple myeloma	40–60 yrs	Axial skeleton	Mild	None	Multiple punched out areas	Yes
Metastatic carcinoma	40–60 yrs	Cancellous bone	Severe	None	Destruction	Yes

The practitioner is cautioned that this chart represents only the more usual characteristics of bone tumors They are often so atypical that only by the histologic appearance may the d agnos s be made with a reasonable degree of accuracy In consequence it is a wise practice for the physician to ref r the pat ent to a consultant who enjoys a close association with an experienced pathologist

smoothly from the cortex of the underlying bone It is capped by an expanded area which shows irregular calcification



Fig 714—A benign osteoma of the skull in an adult which was preceded by trauma The roentgenogram depicts an intact inner table and an outward proliferation of radiating spicules which elevate the periosteum The bone formation is occurring directly in fibrous tissue

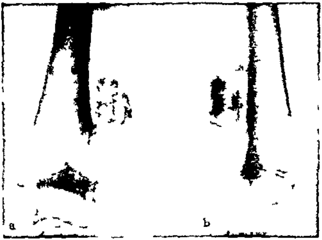


Fig 715—Roentgenograms showing two views of an osteochondroma in a boy of fifteen years at the site of the adductor tubercle in the lower femur The features of the growth depicted in these *roentgenograms are typical*

Treatment—Treatment of the osteochondroma is expectant as long as the tumor is small and evinces no evidence of growth Malignant degener

Geschickter in Christopher A Textbook of Surgery



Fig 716—Roentgenogram of multiple exostoses or hereditary deforming chondrodysplasia The hand and forearm show the combination of exostosis bending deformity and multiple enchondromas characteristic of this disease



Fig 717—Bone cyst of tibia with pathologic fracture †

* Geschickter in Christopher A Textbook of Surgery

† Caldwell, in Pullen, Medical Diagnosis.

ation is uncommon but should be suspected when there is sudden growth and increased pain in an individual who has achieved full bodily growth *Operative removal* offers no difficulty and recurrences are unlikely

CHONDROMAS

The chondroma is a benign tumor composed of *cartilage* The *enchondroma* is a variety which is completely included within the shaft of the bone The enchondroma is often multiple and may involve several bones most frequently in the *hands* and *feet* Other than pathologic fractures symptoms are not associated with these tumors

X *rays* show a round area of diminished density with a smooth and sharply defined boundary in the shaft of bone If treatment is required



Fig 718—Benign giant cell tumor of lower end of ulna Note trabeculated cystic appearance and expansion of the cortex (Drawing from roentgenogram From the clinical material of Dr Vittorio Putti)

the tumor is removed Recurrences are occasionally noted despite the benign character of the neoplasm

BONE CYSTS

Multiple bone cysts may be regarded as manifestations of hyperparathyroidism and they are discussed in the section dealing with the endocrinopathies (p 1226) The solitary bone cyst which may be unilocular or multilocular is most frequently situated in the upper end of femur tibia or humerus It appears as an expanding lesion which thins the cortex its cavity has a smooth wall and contains fluid It is observed most often in late childhood and early adult life and the usual presenting symptom is a pathological fracture (p 2846)

The bone cyst requires surgical treatment the cyst cavity being packed with bone chips

Shands Handbook of Orthopaedic Surgery C V Mosby Company

GIANT CELL TUMORS

Giant cell tumors are ordinarily observed toward the end of the *adolescent period* and in *early adult life* The tumor generally lies in the epiphyseal end of a long bone and becomes manifest first by the appearance of the swelling Pathologic fractures may occur Pain is often prominent

X rays reveal a multiloculated expanded area in the end of the long bone The overlying cortex though considerably thinned is not broken and the articular cartilage of the adjacent joint is not involved



Fig 719 —Osteoid osteoma near the posterior portion of the cortex of the tibia *Left* preoperative view *right* postoperative view The wound was sutured at the time of operation and remained closed *

The giant cell tumor is the province of the orthopedic consultant excision is usually advised and since recurrences are observed post operative roentgen therapy merits consideration

OSTEOID OSTEOMAS

Osteoid osteoma is a tumor composed of a central nidus of osteoid tissue surrounded by marked peripheral bony sclerosis Clinically and radiographically it resembles the syndrome described as *sclerosing osteomyelitis of Garre*

Osteoid osteoma announces itself by persistent severe deep *bone pain* which is often worse at night The pain is well localized and is often associated with sharply defined *tenderness* directly overlying the lesion

* Key in Lewis, Practice of Surgery W F Prior Co Inc

X rays reveal a central area of diminished density with a surrounding zone of bony sclerosis

DIFFERENTIAL DIAGNOSIS OF

Ostealgia

Bone pain is apt to be unusually severe For reasons not clearly understood it may be worse at night, as particularly exemplified by the night cry in tuberculous osteomyelitis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Mechanical and Physical	Fracture malunion, callus exostosis or epiphyseal separation revealed by x rays Aseptic bone necrosis with areas of radio-translucency (p 2806) Subperio teal hematoma (bone bruise) Caisson disease from rapid changes in barometric pressure (bends) (p 1501) Painful heel from spurs of os calcis (p 3052) Get x ray Try procaine injection (p 2814)
Metabolic	
Osteitis Deformans (Paget)	Large skull bowed legs and characteristic x ray appearance (p 2879)
Rickets	Deformities due to epiphyseal changes Therapeutic response to vitamin D and calcium (p 2850)
Scurvy	Subperiosteal hematomas and bleeding gums Therapeutic response to cevitamic acid (p 1120)
Infections	
Osteomyelitis	With fever leukocytosis and localized tenderness Later progressive changes in x rays Institute anti infective therapy (p 2936) Prepare for surgical exploration
Tuberculous Osteomyelitis	X ray evidences of bone destruction and other foci of tuberculosis Positive skin tests Characteristic histologic changes (p 2942)
Chronic Nontuberculous Osteomyelitis	Due to brucellosis actinomycosis or coccidioidomycosis Attempt isolation of pathogen (p 2930)
Syphilitic Osteochondritis	Positive Wassermann Therapeutic re ponse to iodide and penicillin (p 2938)
Trench Fever	With acute pain in shins Brief pyrexia and complete recovery (p 383)
Typhoid Bone Abscess	Chronic ab cess Try to culture invader (p 234)
Neoplastic	
Primary Growths	O teoid osteoma osteogenic sarcoma or endothelial myeloma Confirm by biopsy (p 2836)
Multiple Myeloma	Bence Jones proteose in the urine (p 1126) Myeloma cells identified by marrow smears (p 1043)
Metastatic Carcinoma	Look for distant primary growths

Surgical excision promises complete relief since recurrences of completely removed neoplasms are not seen

GLOMUS TUMORS

See p 1435

NEUROFIBROMATOSIS

See p 1415

NON OSTEOGENIC FIBROMAS

The non osteogenic fibroma is a benign lesion that occurs in the *long bones* of children and adults It is principally a fibrous lesion but may contain foam cells (xanthoma) or giant cells

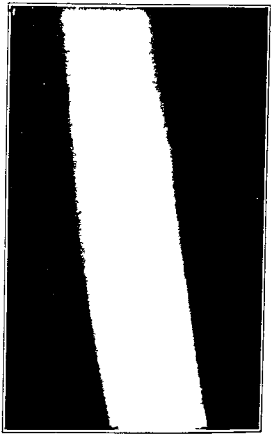


Fig 720—Lesion of eosinophilic granuloma in the shaft of the femur The lesion is circumscribed and shows destruction of the cortex The periosteal reaction is not readily seen in this view *

X rays reveal the appearance of a sharply delimited area of rarefaction adjacent to the expanded cortex There is a dense but thin border surrounding the central clearing *Local excision* is the treatment of choice

FIBROUS DYSPLASIA

In fibrous dysplasia there is replacement of normal bone by a rubbery fibrous tissue which may contain immature bone trabeculae Usually the lesion is multiple and unilateral Evidence that it is due to some profound metabolic disturbance is afforded by the association with *pigmentation of the skin* and *precocious puberty*

* Solomon and Schwartz J.A.M.A., July 7 1945

SYNOVIOMAS

The synovioma is a rare benign tumor that arises from the synovial membrane of joints and tendon sheaths A malignant type of sarcomatous neoplasm may be encountered so that excision is warranted

EOSINOPHILIC GRANULOMA

Eosinophilic granuloma is a rare lesion occurring in the long bones of children and young adults An occasional case has been reported in older individuals *The roentgenographic appearance is that of a destructive lesion invading the cortex and medulla* Microscopically the principal feature is the presence of eosinophils and histiocytes



Fig 721 —Osteogenic sarcoma in upper tibia

Surgical excision and *radiation therapy* have both been used with success recurrence is rare Tumors in inaccessible regions have been noted to disappear spontaneously

OSTEOGENIC SARCOMAS

Osteogenic sarcoma is the most frequent of primary malignancies of bone It usually is encountered during *late childhood* or *early adult life* and involves the ends of shafts of long bones usually in the regions of *knee* or *shoulder*

Osteogenic sarcoma is accompanied by severe and early *pain* associated with a *rapidly increasing swelling* The more rapidly growing tumors may

DIFFERENTIAL DIAGNOSIS OF

Swellings of Bone

Swelling of bone is an unusual and arresting manifestation which requires intensive investigation by practitioner and consultant orthopedist

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Mechanical and Physical	Fractures with displacement or malunion (p 2988) Subperiosteal hematoma ("bone bruise") Callus Bunion Exostoses Circumferential cupping around sebaceous cyst of skull (p 3208)
Metabolic Disturbances	
Acromegaly	With other evidences of anterior pituitary hypersecretion (p 1156) Note deformities of sella turcica Refer to neurosurgeon.
Gout	Metabolic disorder of purine metabolism. Note high blood uric acid tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine (p 2874)
Hypertrophic Pulmonary Osteoarthropathy	Clubbing of fingers Look for pulmonary or cardiac disease (p 953) Get blood culture for subacute bacterial endocarditis (p 1021)
Melorheostosis	With appearance of dripping candle Due to unknown metabolic disorder (p 2878)
Osteo-arthrosis	Usually affects obese middle-aged patients with hypometabolism Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine (p 2862)
Osteitis Deformans (Paget's Disease)	With enlargement of skull and bowing of tibias (p 2879)
Rickets	Frontal bosses and rosary (p 2850) Therapeutic response to vitamin D and calcium
Scurvy	With subperiosteal hematoma (p 1120) Therapeutic response to cevitamic acid.
Infections	
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine (p 2925)
Chronic Pyogenic Osteomyelitis	With formation of involucrum (p 2930) Try anti infective therapy (p 106) Refer to surgeon
Tuberculous Osteomyelitis	Particularly of fingers (dactylitis) and spine (p 2942) Look for acid fast lesions elsewhere (p 2199)
Syphilis	Osteochondritis or gumma formation with positive serology Therapeutic response to iodide and penicillin (p 2938)

Neoplastic	Especially enchondromas and osteogenic sarcomas Latter may pulsate (p 2843) Refer to orthopedist for bone biopsy and recommendations as to treatment

be accompanied by moderately severe constitutional symptoms including *fever*

X *rays* show osteogenic and osteolytic activity in varying proportions There may be marked destruction of cortex through which the tumor may burst to invade adjacent structures there may be a sunray appearance of new bone formation on the surface of adjacent cortex due to periosteal deposition as the tissue is raised from the surface of cortex by tumor cells Osteolytic tumors are often exceedingly vascular and may pulsate giving rise to the description of a bone aneurysm



Fig 722—Roentgenograms of Ewings sarcoma in the upper portion of the humerus a January 1935 before irradiation shown widening of the cortex and splitting of the periosteum in onion peel fashion b September 193 after deep roentgen therapy The patient has continued to be well (1938)

The prognosis in osteogenic sarcoma is bad Some of the tumors have a considerable proportion of cartilage (chondrosarcoma) and these afford a somewhat better outlook since they are comparatively late in producing metastases

The ominous outlook of osteogenic sarcoma justifies complete *amputation* followed by *irradiation*

ENDOTHELIAL MYELOMAS (EWINGS TUMOR)

The Ewing tumor is a malignant bone neoplasm that most often arises from the middle of a shaft of a long bone during *childhood* or *adolescence* The growth is accompanied by *pain tenderness fever* and *leukocytosis*

Geschickter in Christopher A Textbook of Surgery

DIFFERENTIAL DIAGNOSIS OF

Pathologic Fractures

Pathologic fractures occur as the result of minor traumas The condition is most often seen, in aged and senile patients as a lesion of the upper end of the femur Under any circumstances the pathologic fracture has serious prognostic implications

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Metabolic Disturbances	
Hyperparathyroidism	With cyst formation hypercalcemia and hypophosphatemia (p 1225) Seek demonstrable adenomas of parathyroid gland (p 1233) Consider surgical excision
Osteitis Deformans (Paget s)	With enlargement of skull thickening of cortex and bowing of legs (p 2879) Note high serum alkaline phosphatase (p 728)
Osteomalacia	Associated with vitamin D insufficiency and pregnancy Give calcium and vitamin D
Osteogenesis Imperfecta (Fragilitas Ossium)	Of congenital origin With blue sclerae and deafness (p 2798)
Osteopetrosis	Apparent thickening of bone but chalk like brittleness (p 2798)
Osteoporosis	In aged and debilitated patients Most often involves weight bearing joints particularly femur (p 2515)
Systemic Reticulo-endothelioses	With cutaneous xanthomas splenomegaly and characteristic cells (Gaucher) in smears of sternal marrow (p 1043)
Neoplasms	
Bone Cysts	Solitary bone cysts of long bones Get x rays and consult orthopedic specialist
Chondromas	Of shaft of femur (p. 2839) Obtain biopsy (p 2836) and refer to orthopedic consultant.
Giant Cell Tumors	Of epiphyseal ends Note multiloculated areas with thinned but unbroken cortex (p 2840)
Metastatic Carcinoma	Evidences of primary lesion elsewhere in body (p 2848)
Multiple Myeloma	Bence-Jones proteosuria myeloma cells in bone marrow smears and multiple areas of involvement (p 1126)
Neurogenic	
Tabes Dorsalis	Loss of deep reflexes and pupillary changes (p 1464) Positive Wassermann of cerebrospinal fluid
Hemiplegia	Unilateral spastic paralysis. Usually follows cerebral accident (p 1439)
Trauma	March fractures of metatarsals in soldiers (p 2983)
Infectious and Inflammatory	Chronic pyogenic osteomyelitis and weakening of bone Note x ray changes (p 2930) In tuberculous osteomyelitis Earlier lesion usually in lung Note x ray changes (p. 2942) In association with typhoid abscess of bone Obtain organism by aspiration (p 53)

and it closely simulates low grade osteomyelitis This differentiation may be difficult even when the lesion is exposed at operation since the myeloma contains soft tissue that resembles grumous pus

The *x ray* is fairly typical in that there is an onion peel formation of concentric layers of new bone formation laid down by periosteum about the area of bony destruction With the area well localized by the x ray an *aspiration biopsy* may yield cells from which the diagnosis can be made

Treatment—The Ewing tumor shows a rapid and early response to *roentgen therapy* The tumor regresses rapidly but then recurs in a radioresistant form *Surgical excision* is equally unsatisfactory and the



Fig 723—Pathologic fracture through the neck of the left humerus in case of myeloma

prognosis remains extremely bad despite adequate and competent combination therapy of surgery and irradiation The mixture of *erysipelas toxin* and *Bacillus prodigiosus vaccine* recommended by Coley appears to have some value and should be used as a remedy of desperation The injection is followed by a serious febrile reaction

MULTIPLE MYELOMAS

Multiple *myelomas* are malignant bone tumors which arise in the later age group from forty to sixty years The bony lesions are usually found in the *axial skeleton*

Geschickter and Copeland Tumors of Bone

The onset of the disturbance is insidious with vague *pain local swelling* or *pathologic fractures* as herald manifestations Later the patient develops *secondary anemia* and *severe cachexia* *Bence Jones albuminuria* (p 3672) is a confirmatory finding and is not always present The most important definitive laboratory assistance is obtained from *sternal puncture* (p 1043) which reveals the typical myeloma cells

X rays show multiple, punched out areas in the bones of the axial skeleton particularly the *skull* and *ribs* There is very little new bone formation and the involved sites show pure bone destruction

The prognosis is bad *roentgen therapy* may afford some temporary amelioration but the disease progresses to a fatal termination within a variable time

METASTATIC BONE TUMORS

Metastatic deposits are the most common malignant bone tumors They occur most frequently in the older age group The primary lesion

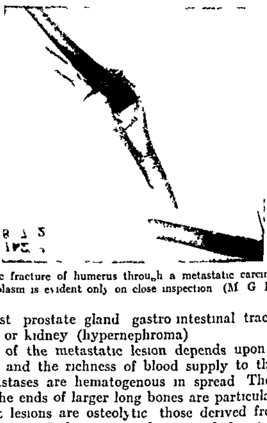


Fig 794—Pathologic fracture of humerus through a metastatic carcinoma Note that the neoplasm is evident only on close inspection (M G H)

often is in breast prostate gland gastro intestinal tract lungs female genitals thyroid or kidney (hypernephroma)

The location of the metastatic lesion depends upon the site of the primary growth and the richness of blood supply to the affected bone since most metastases are hematogenous in spread The axial skeleton ribs spine and the ends of larger long bones are particularly prone to involvement Most lesions are osteolytic those derived from the prostate may be osteoplastic and show areas of increased density with increased blood acid phosphatase

The earliest symptom is usually pain but a *pathologic fracture* may attract attention to the area *Stiffness* and *limitation of motion* are also observed at an early phase and x ray manifestations may not be obvious for a considerable time thereafter

* Scudder The Treatment of Fractures

The prognosis is wholly ominous Local *treatment* is *palliative* by means of opiates (p 3853) and roentgen therapy With *breast lesions* the patient should be castrated and given injections or implants of testosterone the patient with carcinoma of the *prostate* should be castrated and given stilbestrol (p 2515) Following removal of a *hypernephroma* regression of metastases has been noted

CHAPTER 133

THE SKELETAL AND LOCOMOTOR SYSTEMS DISTURBANCES OF METABOLISM AND GROWTH INCLUDING DEGENERATIVE PHENOMENA

The complexity of bone metabolism has been emphasized in the introductory material Among the known factors concerned in the process are the intake absorption physical state and excretion of calcium in turn these are modified by or dependent upon the hydrogen ion concentration (pH) of blood and tissue fluid the chemical interrelationship with phosphate and carbonate the tension of oxygen and carbon dioxide the influences of vitamin D and the hormonal factors relative to thyroid parathyroid anterior pituitary and gonadal secretions

With even a cursory knowledge of the profundity of the metabolic changes inherent in the chemistry of the skeleton it is no small wonder that the clinician is confronted with a wide variety of clinical syndromes which defy classification and must be catalogued as purely descriptive entities Even after separation of those phenomena that are obviously due to vitamin deficiency and endocrinopathies there still remains a much larger group which must be regarded as of unknown or idiopathic origin For present purposes the following classification must suffice

Avitaminoses
- Infantile Rickets (Rachitis)
- Adult Rickets (Osteomalacia)

Endocrinopathies (p 1144)

Osteo arthrosis (Chronic Senescent Hypertrophic Arthritis Degenerative Arthritis Osteo arthritis Arthritis Deformans (p 2855)

Gout

Symptomatic and Descriptive Metabolic Osteo arthropathies (p 2878)

Muscle Dystrophies (p 2880)

Fatigue and Exhaustion States (p 2888)

INFANTILE RICKETS (RACHITIS)

Rickets is a disease of infancy and childhood in which there is a disorder of calcium and phosphorus metabolism usually dependent upon an insufficiency of vitamin D less frequently the changes result from calcium deficiency or phosphate retention (renal rickets)

Pathology—The principal pathology of rickets is noted in relation to bone growth derangement of *epiphyseal activity* impairs formation of *osteoid tissue calcification* is imperfect, and the bone is relatively soft and plastic yielding to stresses and strains Deformities are caused by the effects of gravity and the physiologic pull of muscles

Clinical Manifestations—The clinical manifestations of rickets may be generalized or relative to the skeletal system The former appear early

and are not specific they consist of *restlessness irritability sweating diarrhea* or *constipation* and recurrent attacks of *bronchitis liver* and



Fig 725

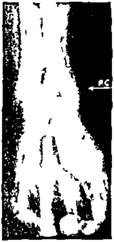
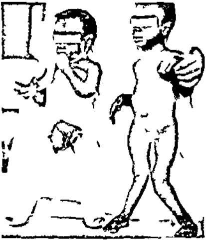


Fig 726

Fig 725—Marked rickets in an infant of ten months of age showing cupping enlarged diaphyses and hazy outline of epiphyses and periosteal elevation in the metacarpal bones
Fig 726—Healing rickets in a patient of thirteen months of age showing zone of preparatory calcification (P C)



A B

Fig 727—A Rachitic knock knees corrected by supracondylar osteotomy and maintained in a double plaster spica. *B* Similar case before operation †

spleen may be enlarged the *musculature* is poorly developed and the *subcutaneous tissue* is flabby

Osseous manifestations are quite specific Many deformities arise as the result of abnormal softness and plasticity in poorly calcified bone the

Griffith and Mitchell Textbook of Pediatrics
† Lewin Orthopedic Surgery for Nurses Including Nursing Care 3d Ed

CHAPTER 133

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Fatigue and Exhaustion States (p 2888)

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Clinical Manifestations—The clinical manifestations of rickets may be generalized or relative to the skeletal system The former appear early

a diminished density on the convex side and increased thickness of the cortex on the concave side

Treatment—The specific treatment of rickets is described elsewhere (p 621) It requires adequate intake of *vitamin D* and *calcium* The response to therapy constitutes a *therapeutic test*

Skeletal deformities if mild may improve without specific mechanical therapy Mild bowing of the legs and knocking of the knees show a tendency toward spontaneous improvement after the fundamental metabolic disorder has been corrected More severe degrees of deformity may require



Fig 99—A case of osteomalacia (Painter) Note supracondylar (fractures) deformities of the femora and similar deformity of forearm

osteotomy or osteoclasis with resetting of the bone in the corrected position

ADULT RICKETS (OSTEOMALACIA)

In the adult whose bone growth has been completed the metabolic disturbance that is responsible for infantile rickets is no longer manifest solely at the epiphyseal lines instead there is generalized and progressive softening of the entire skeleton

Adult osteomalacia a relatively rare disturbance is usually caused by a *prolonged negative calcium balance* This may result from a diet that is

Scudder The Treatment of Fractures

skull is large and may show *bosses* or prominent frontal areas the *cranium* itself is soft and exhibits the phenomenon of *craniotabes* in which digital pressure causes a sense of crackling The *thorax* is characterized by the *rachitic rosary* which is due to enlargement of the costochondral junctions and may also reveal *Harrison's groove* a transverse depression around the lower portion of the thorax due to the pull of the diaphragm The spine often exhibits *kyphosis* *scoliosis* or a combination of the two curvatures *bowlegs* and *knock knees* are very prevalent *coxa vara* may occur

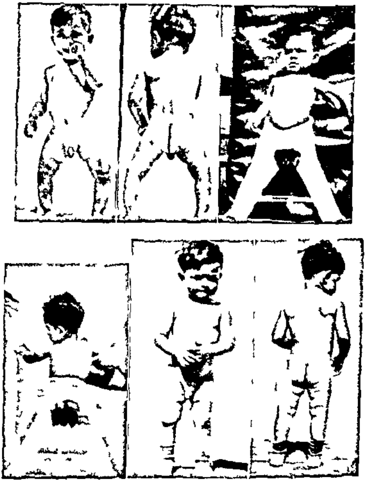


Fig 428—Bowlegs (genu varum) in a child of three years Multiple osteotomies and double spica cast *

the child is retarded in standing and walking The *teeth* appear late and closure of the *fontanelles* is retarded Blood chemical studies reveal a normal calcium value reduced plasma phosphorus and high phosphatase

X rays show pathognomonic findings The ends of the diaphyses are cupped and flared and their margins are irregular and indistinct the epiphysis shows irregular calcification the epiphyseal line is broadened the shafts of the bones particularly revealed in the tibia are bowed with

* Lewin Principles and Practice of Physical Therapy Vol 2 W F Prior Co Inc

now extremely rare and the disease is principally limited to infants between six and eighteen months of age

Pathology—The principal pathologic change is an increased tendency to hemorrhage, particularly in the subperiosteal and submucosal planes The resultant hematoma elevates periosteum from bone spontaneous separation of epiphyses follows minimal trauma bleeding and swelling of the gums occur after the teeth have erupted

Clinical Manifestations.—The scorbutic infant is irritable and poorly nourished The arresting symptoms are *swelling* and severe *pain* on motion of affected extremities There may be pathologic separation of the epiphysis with growth deformity and obvious crepitus on motion the bone may be palpably thickened due to subperiosteal hemorrhage the extreme pain induced by motion may lead the child to remain immobile (*pseudo paralysis*)

Treatment—Treatment necessitates a diet containing an adequate supply of vitamin C and the ingestion or parenteral injection of *cevitamic acid* (*p 627*) *The response to therapy constitutes a therapeutic test* Deformities of the epiphyses usually recover spontaneously with excellent functional and cosmetic results

OSTEO ARTHROSIS (CHRONIC SENESCENT ARTHRITIS HYPERTROPHIC ARTHRITIS DEGENERATIVE ARTHRITIS OSTEO ARTHRITIS ARTHRITIS DEFORMANS)

The clinical entity under present discussion is a metabolic derangement that involves bones and joints We favor the use of the term osteo arthrosis since the affliction is non inflammatory and hence should not be called arthritis The modifying adjectives of the alternate titles are equally misleading since hypertrophy is only one manifestation of the pathologic process and deformities are more frequently absent than present neither can the disturbance be regarded as degenerative or senescent since it is apt to occur in a large number of otherwise normal persons between the ages of thirty five and forty five years

Osteo-arthrosis is of unknown origin It is characterized by *atrophy* and *degeneration* of cartilage with *hypertrophy* of bone margins The condition is not related directly to infection but resembles a process of wearing out to which presumably every joint is liable if the subject lives sufficiently long

Etiology—Although the primary etiologic factor in osteo arthrosis eludes present knowledge there are definite local and systemic factors which predispose to the appearance of this condition

Local predisposition results from factors which increase the effects of wear and tear upon the joints Prolonged hard usage by strenuous activity or by reason of *excessive obesity* tend toward the early appearance of osteo arthrosis This cannot be the entire mechanism however since the Heberden s nodes so characteristically found in the fingers are often present in women who have performed little or no manual work *Injury or damage* to a joint by a previous infection and an *incongruity of the joint surface* also favor the early appearance of osteo arthrosis

Systemic predisposing factors are principally hereditary and glandular There can be no doubt of the *familial prevalence* of osteo-arthrosis the

deficient in calcium and/or vitamin D It is observed most often in women who live in tropical climates and who remain indoors away from the sun subsisting on a deficiency diet they are further embarrassed by repeated pregnancies which further deplete their depots of lime

Pathology—Decalcification of the skeletal system is generalized the bones are soft and flexible the cortex is so greatly thinned that the bones appear translucent in the x ray A great number of deformities result from the generalized skeletal softening most frequent are *bowlegs kyphosis scoliosis* and a type of *deformity of the pelvis* which narrows the birth canal often interfering with normal pregnancy and necessitating cesarean section Pathologic fractures may occur

Diagnosis—The diagnosis of osteomalacia is made evident by the typical findings on roentgen examination The roentgenogram reveals osteo



Fig 730—Roentgenogram of infant with scurvy *

porosis and a washed out appearance of the bone Almost always there is a history of deficient intake of calcium in the diet often coupled with inadequate amounts of sunlight or vitamin D

Blood calcium and phosphorus levels are low or normal while phosphatase is elevated

Treatment—Osteomalacia is treated by dietary and accessory increments of *calcium* (p 604) and *vitamin D* (p 621) deformities may require orthopedic correction

INFANTILE SCURVY (SCORBUTUS)

Scurvy is a deficiency disease resulting from an inadequate intake of vitamin C (cevitamic acid) It may occur at any age but adult cases are

* Caldwell in Pullen Medical Diagnosis

by endochondral ossification These osseous outgrowths give rise to *osteophytes* which produce *spurring* and *lipping* of joint margins

As cartilage continues to erode underlying bone is left exposed and becomes *eburnated* and ivory hard There is little or no associated bone atrophy except where the disability has been sufficiently severe to produce an atrophy of disuse.

Restricted motion of varying degree is always present in advanced cases, but *ankylosis* of the joints does not occur—in contrast to the condition that exists in infectious varieties of true inflammatory arthritis (p 2802)

The effects of trauma are illustrated by early involvement of weight-bearing joints and those employed in manual labor In the female, the order of involvement is often *fingers* (Heberden's nodes) *knees* and *cervical spine* the male shows a predilection for involvement in *lumbar spine shoulders* and *hips*

Several clinical varieties of osteo-arthrosis are recognized but their separate description serves no useful purpose *Heberden's nodes* refers to the process in the distal interphalangeal

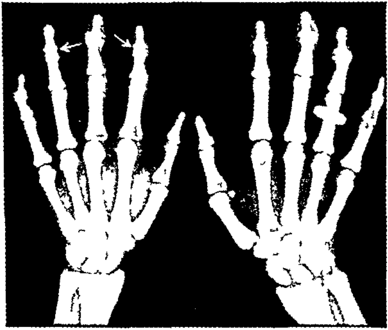


Fig 31 —X ray of hands in a case of degenerative joint disease Arrows point to very early lesions Late hypertrophic changes (Heberden's nodes) are also evident

joint of the fingers *spondylitis deformans* represents the process in the spine and *malum coxae senilis* is an osteo arthrosis of the hip of the older patient.

Clinical Manifestations —The vast majority of individuals with osteo arthrosis present no clinical manifestations Most often the skeletal deformity passes without notice or serves as a chance finding during the physical examination on the roentgenograph or at necropsy It is more than likely that routine x rays taken of all individuals beyond the age of forty would show more or less significant evidences of osteo arthrosis

The patient who complains of the effect of an osteo-arthrosis usually notes *pain swelling limitation of motion effusion* into a joint and *crepitus* The symptoms usually arise in the late thirties or early forties although

stocky individual develops the disturbance with comparative frequency often in association with allied disturbances such as *obesity hypothyroidism diabetes mellitus arteriosclerosis angina pectoris* and *coronary sclerosis*

Osteo arthrosis often becomes apparent at the time of the menopause producing so called *climacteric arthritis* It is more frequent in patients who

DIFFERENTIAL DIAGNOSIS OF

Endocrinal Osteo arthropathies

Many endocrinopathies are associated with changes in the skeletal and locomotor systems The table which follows lists these for orientation and provides references to more complete discussions

	CLINICAL MANIFESTATIONS IN SKELETAL SYSTEM
Hyperthyroidism	Generalized osteoporosis resulting from prolonged acceleration of all metabolic processes. Get B M R Note therapeutic response to high calcium feeding and iodide or deracil (p 1197)
Hypothyroidism	Dwarfism in cretins Due to retardation of epiphyseal growth centers Note therapeutic response to thyroid extract (p 1191)
Hypersecretion of Anterior Pituitary Growth Hormone	Giantism in pre adolescents due to accelerated function at growing epiphyseal lines (p 1155) Acromegaly in post adolescents due to deformities at closed epiphyseal lines (p 1156) Epiphysitis in dyspituitarism of Frohlich type producing Legg Calve-Perthes disease etc (p 1166)
Hyperparathyroidism	Productive of hypercalcemia and hypophosphatemia Resultant generalized osteoporosis or localized fibrocystic disease of bone (von Recklinghausen) Multiple pathologic fractures (p 1225) Consider excision of parathyroid adenomas
Hypogonadism	Senile osteoporosis of spine Decalcification of vertebral bodies fishtail expansion of intervertebral disks and kyphosis May respond to feedings of calcium and vitamin D Try injections of estrogen and androgen (p 2515) Climacteric and menopausal arthritis probably manifestations of osteoarthrosis (p 2855) with exacerbation during endocrine crisis Note effects of androgen and estrogen

exhibit a *low basal metabolic rate* with or without clinical evidences of *thyroid deficiency*

Pathology—The principal pathologic changes are manifested as *fibrillation* and *atrophy* of joint cartilage which becomes roughened and shows tiny elevations similar to those seen on a piece of velvet The *synovia* may show evidences of inflammation and there may be a moderate degree of *serous effusion* into the joints The periphery of the articular cartilage begins to proliferate and typical *bony exostoses* characteristic of this conditi

pated with the palm of the hand while the joint is put through its range of motion The subpatellar crepitus of the knee joint is often audible several feet away

The areas of predilection for the osteo arthrotic process have been previously discussed often there seems to be an orderly sequence beginning in the *fingers* and progressing *to lumbar spine knees cervical spine shoulders* and *hips*

At times osteo arthrosis becomes manifest through an *acute episode* there may be the development of a *low back strain* or a *radiculitis* usually of sciatic distribution the symptoms may result from the fracture of an osteophyte These conditions lead to a further investigation and reveal the fact that there is a pre existent generalized articular disturbance

An accessory and common finding in osteo arthrosis is the presence of *synovial cysts* These are best seen in the region of Heberden s nodes they contain a glairy thick fluid which tends to reappear after drainage



Fig 34 Spondylitis deformans (osteo arthritis of spine)

Osteo arthrosis also is associated with manifestations of *fibrositis* and *atrophic myositis* The latter is seen with disuse secondary to joint limitations and pain fibrositis tends to develop in regions where there is strain most particularly over the sacro iliac junction posteriorly

Osteo-arthrosis of the Spine (Arthritis Deformans of the Spine Degenerative Spondylitis) —Degenerative spondylitis is a localized form of generalized osteo-arthrosis It is found most frequently in the old age group and particularly in those who have subjected the spine to excessive wear and tear because of occupation (*longshoremen*) or excessive obesity The disturbance is often the result of prolonged poor posture or a scoliosis which results in malalignment of the normal joint surfaces

Osteo arthrosis of the spine is generally *observed* in sthenic individuals who are overweight Ordinarily there is a prolonged history of *stiffness* and *pain in the back* made worse by changes in weather and particularly noted on arising after sleep or following a prolonged period of recumbency The back generally feels better after the patient has moved about for a

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joints which have been previously damaged by fractures congenital deformity or an inflammatory arthritis often begin to creak as early as the third decade

Pain is usually most severe when activity is resumed immediately following rest upon arising in the morning or on getting out of a chair the patient notices stiffness and pain in the joint the discomfort gradually wears off as it is worked out' and it is this reaction that makes the patient reluctant to accept the prescription of rest Pain is also notably worse with change in weather although the reason for this is not clear

Swelling of the joint often precedes pain or stiffness, it is due to thickening of the synovial capsule or the presence of osteophytes The latter are easily palpated particularly in the terminal interphalangeal joints where they form the typical knobby expansions known as *Heberden s nodes* It is

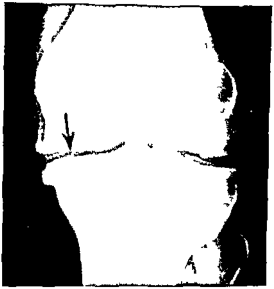


Fig ~3? —Hypertrophic changes in the knee Note the lipping and the calcified deposit in the joint space *

worth noting that in rheumatoid arthritis (p 2910) the proximal interphalangeal joints are involved

Stiffness and *limitation of motion* are often overlooked to a surprising degree the disturbance progresses so insidiously that the patient does not note the handicap

Effusion into the joints occasionally occurs and is only moderate in degree The fluid is serous and ordinarily appears after some unusual amount of joint activity or local trauma Aspiration is rarely necessary since these effusions usually subside with rest and the application of an elastic bandage

Joint tenderness is generally present to a varying degree but is rarely severe it is most apt to be observed about the inner knee joint margins where there is particular stress due to faulty foot mechanics *Crepitus* is a characteristic finding and is often noted by the patient It may be pal

* McCombs Internal Medicine in General Practice

the distal interphalangeal joints of the fingers They are usually associated with synovial cysts which rupture and reform They may exist for years without producing symptoms Often they precede other manifestations of the disturbance and sometimes they remain the sole presenting lesion

Malum Coxae Senilis—Malum coxae senilis is an osteo arthrosis of the hip It is not an isolated manifestation but may be most marked It is often unilateral Injuries to or infections of the hip constitute significant predisposing factors as do congenital abnormalities (shallow acetabulum) or growth disturbances (Legg Perthes disease)

Roentgenographic Findings—The x ray findings in osteo arthrosis have both *positive* and *negative* values They are of positive assistance when there is doubt concerning the variety of the arthropathy More frequently however the x ray findings are of negative value since they reveal little or no change in the early phases of the disturbance and by contrast may



Fig 73 —Hands in degenerative joint disease (hypertrophic arthritis)

show advanced manifestations as chance findings in individuals who do not suffer from the affliction until their attention has been called to the roentgenogram

In the early stages of the disturbance the only appreciable alteration is *narrowing of the joint space* which results from thinning of the cartilage in extreme instances the opposing bones seem to be in actual contact although ankylosis does not develop The borders of the articulating surface present *marginal lipping* with *osteophytes spurs* and *bone bridges* Thickening is also noted in subchondral bones these changes may be mild to extreme and are not proportional to the amount of clinical symptoms

Laboratory Data—The laboratory affords little assistance in the diagnosis of osteo arthrosis aside from the frequent presence of a *diminution in the basal metabolic rate* (p 719) the blood count blood chemical analysis sedimentation rates and blood cultures show no significant alterations

Courtesy of Dr Ralph Pemberton

while Often the history of chronicity is interrupted by periods of *acute back strain* usually described as lumbago, sciatica kidney trouble by which is meant lumbar pain or as acute cricks

The motions of the back are restricted in all directions and the limitations persist in the absence of muscle spasm Since the posterior spinal articulations are immediately adjacent to the foramina for the exit of spinal nerves radicular pain particularly of *sciatic distribution* accompanies osteo arthrosis of the spine The immediate cause for the pressure may be impingement by an osteophyte or more probably a surrounding edema The *straight leg raising tests* are often positive (p 3064) and local

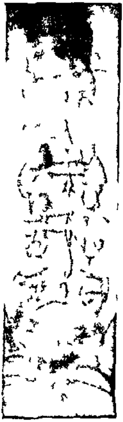


Fig 734—Anteroposterior roentgenogram of lumbar vertebrae showing extensive hypertrophic arthritis with complete bony bridging of rhizomelic spondylosis or poker back *

ized areas of thickening and fibrositis are observed as trigger points These are important to note since they may be painful and tender and can be effectively anesthetized by the injection of procaine (p 2814)

Roentgenographs in osteo arthrosis of the spine show typical spurring and lipping of the joints between the vertebral bodies Often these are more apparent on the lateral than on the anteroposterior views Visualization of the posterior articular facets requires an oblique or three quarter lateral view

Heberden s Nodes—Heberden s nodes represent an osteo arthrosis of

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it is not a crippling form of rheumatism but rather a manifestation of a process of ageing similar to the graying of hair He is to be told with frankness that the condition cannot be cured that there are no miracles of therapy to be performed inside or outside the medical profession and that within reason the control of the affliction is entirely in the hands of the patient and his family It is good practice to warn against miracle workers and to extract a promise that no form of therapy will be attempted without consultation with the practitioner

Systemic Treatment—The systemic treatment of osteo arthrosis consists in the main in denial of enthusiastic claims of those whose hopes far outdistance their judgment Despite the length of the list and the tediousness of explanation the practitioner owes it to the patient and himself to go through the roster lest the patient in his meanderings learn of a form of therapy of which he believes his practitioner to be ignorant

Diet—A *low calory diet* (p 697) is useful in those cases in which patients suffer from obesity This should be supplemented by corrective and then maintenance doses of *thyroid extract* (p 1189) if there is a diminution in the basal metabolic rate

Dietotherapy other than for this indication is mostly a matter of fad and fancy At one time or another patients have been deprived of red meat acids and acid foods citrus fruits starche carbohydrates and salts Again there was a vogue for eating proteins with one meal and starches with another so that the two might not be mixed Reinforcement with vitamin preparations is an inevitable suggestion which reaches its most vociferous stage with the suggestion that the patient be given relatively enormous doses of vitamin D but there is obviously nothing to be gained by a ride on these hobby horses

Pharmacotherapy—The list of drugs which have been recommended as having specific effect in osteo arthrosis is so long that it must be manifest that no one of them possesses anything other than limited symptomatic potentiality

Among the *glandular preparations* thyroid and estrogen judiciously employed often afford some comfort when the indication for their use is clear Patients with a low basal metabolic rate should be given *thyroid extract* (p 1189) in corrective and then maintenance dosage both for substitution therapy and to assist in weight reduction women at the time of the menopause sometimes seem to manifest some diminution in symptoms when they are given *estrogen* (p 2515)

The advocates of *vitamin therapy* have been particularly insistent upon the administration of large doses of vitamins D and A A preparation known as *Ertron* has been widely advertised to the medical profession Despite enthusiastic claims there seems to be nothing accomplished by this preparation beyond that which the experienced clinician is apt to see in the natural course of the disturbance

Drugs that have been advocated for use in osteo arthrosis include sulfur silver colchicine alkalies iodides lithia histamine and cincophen We have no faith in the efficacy of any of these and certain of them are dangerous Injections of *sulfur* have been discarded by all thinking physicians and *alkalinization* is without rational or practical efficacy the injection of *gold salts* in osteo arthrosis is not advocated by even the most

Differential Diagnosis—The first consideration in the differential diagnosis of osteo arthrosis is directed toward the problem of rheumatoid arthritis as summarized in the following table

DIFFERENTIAL DIAGNOSIS OF

Osteo-Arthrosis and Rheumatoid Arthritis

	OSTEO ARTHROSIS	RHEUMATOID ARTHRITIS
Age of Onset	Beyond 35 years	Before 35 years
Nutrition	Overweight	Underweight
Habitus	Sthenic	Ptotic
Temperature	Normal	May be elevated
Pulse Rate	Usually slow	Tachycardia
Basal Metabolic Rate	Usually low	Normal
Hemogram	Normal	Anemia and leukocytosis
Sedimentation Rate	Normal	Rapid
Prodromal Systemic Symptoms	No	Usual
Muscle Atrophy	Slight	Marked
Vasomotor Instability	Unusual	Usual
Effusion	Unusual	Usual
Ankylosis	Unusual	Usual
Extremities	Terminal interphalangeal joints involved	Proximal interphalangeal joints involved
X ray	Narrowing of joint spaces lipping spur formation	Narrowing of joint spaces with later effusion synovial thickening ankylosis and bone atrophy
Course	Little progression	Exacerbations and remissions with eventual crippling

After elimination of rheumatoid arthritis the practitioner turns his attention to the possibilities of fibromyositis gout and bacterial arthritides

Fibromyositis (p 2895) occurs most often in asthenic individuals and the negative findings include both the laboratory and the x ray data

Typical gout is associated with *hyperuricemia* (p 737) and *tophi* containing uric acid crystals Its symptoms are relieved by the administration of *colchicine* (p 2874)

The *bacterial arthritides* are best diagnosed from the associated conditions and the character of the aspirated joint fluid (p 2801)

Treatment—The science of medicine has no specific form of therapy to offer the patient with osteo arthrosis damaged cartilage cannot be regenerated and the disturbance is irreversible However this prospect must not discourage the practitioner or patient since the skillful exercise of the art of medicine will permit the afflicted individual to live his life with relatively slight inconvenience and only a remote possibility of incapacitation and invalidism

Psychotherapy—The first and most important step in the management of osteo arthritis is an explanation by the practitioner to his patient of the nature and course of the disease and the measures that must be undertaken for its control The patient must be given to understand that

Bee Venom—The use of bee stings and bee venoms crops up periodically as a therapeutic measure in rheumatism This form of counterirritation has no real place in modern clinical practice

Care of the Bowels—Many physicians believe that auto intoxication is a contributing factor in the production of osteo arthrosis On this basis they advise *colonic irrigations implantations of colon bacilli* or *bacillus acidophilus* and purging with salines or calomel At best these measures offer transitory symptomatic relief

Local Treatment—Local therapy has much to offer the patient with osteo-arthrosis The patient can carry out most of his therapeutic regimen without professional assistance He should be informed that treatment is to be continued indefinitely because of the chronic and irreversible nature of the affliction

REST—*Despite the fact that the patient notices an increase in symptoms* after a period of rest he must be informed of the importance of *protecting* his joint surfaces from wear and tear in so far as is possible The patient should not walk when he can ride he should not stand when he can sit he should avoid climbing stairs and if necessary should move his residence to a ground floor *Change of occupation may be necessary for* those who do heavy labor Patients who have intractable pain are often surprisingly improved after a *week end in bed* or a complete *rest cure* lasting two or three weeks

THE CORRECTION OF EXISTING DEFORMITIES—The general principle of rest is aided by the correction of existing abnormalities *Weight reduction* has been previously discussed and is perhaps the greatest single factor in the amelioration of manifestations referable to the weight bearing structures

Postural abnormalities require support or correction It has been previously noted that the joint that is ineptly used is most apt to show the earliest and most severe manifestations of the osteo arthrosis It is both gratifying and amazing to note the improvement that occurs particularly in women who are overweight when *foot mechanics* are corrected In the heavy and obese woman with knock knees the weight may be shifted towards the inner portion of the knee joint by placing a *wedge* $^3/_{16}$ of an inch thick on the inner border of the heel The prescription of a *proper shoe* may accomplish a great deal more than many of the imposing forms of therapy An old fashioned laced *corset* properly fitted and applied greatly relieves heavy flabby women The *surgical corset* and the *sacro iliac belt abdominal supports* and *braces* for the lower back often make *the difference between comfort and abject misery* The Knight spinal brace p 3070) is admirably adapted for use in spondylitic manifestations

The fitting and prescription of these adjuvants require skill and experience It is often more satisfactory to refer the patient to the specialist orthopedic surgeon for these purposes

EXERCISE—Despite the importance of rest for the traumatized joints exercise is important to the non involved structures Exercises are best carried out in a non weight bearing attitude by *floor work* (p 3757) *Postural exercises* (p 3757) are exceedingly valuable in the treatment of osteo arthrosis of the spine *Quadriceps exercises* are useful in the treatment of afflictions involving the knee

HEAT—Local heat is the greatest comfort to the patient who suffers

enthusiastic user of these preparations and they have a real potentiality for harm because of the frequency of serious toxic phenomena *colchicine* of great value in the symptomatic relief of gout produces untoward symptoms much too frequently for use in a chronic disturbance such as osteoarthrosis, *cincophen* (p 3833) and allied preparations including *tolysin* are best avoided because of the remote chance of a toxic hepatitis they are safely replaced by the simpler *analgesics* (p 3832) the administration of *iodides* is a remnant of the dim past when tertiary syphilis was frequent and there was always the chance that the patient might exhibit a specific response *lithia* is now an obsolete preparation except in the advertisements seen in the drug stores *histamine preparations* are without value

Analgesics such as *salicylates* (p 3832) and *coal tar preparations* notably *acetylsalicylic acid* (p 3832), afford symptomatic relief and should be used by the patient when necessary It is not good practice to leave standing orders for these drugs since sooner or later they produce gastric irritation and loss of appetite

Biological Therapy —Since osteo arthrosis is not an infectious condition there is little to be gained by the use of *serums* or *vaccines* This has not prevented the injection specialists from plying their trade using *antistreptococcal serum* because of the purported resemblance to rheumatic fever *stock vaccines* containing streptococci and staphylococci or *autogenous vaccines* prepared from the normal flora and fauna of the nose throat tonsils sinuses teeth or stool

Injection forms of treatment are also carried out with various forms of *foreign protein* such as boiled milk typhoid vaccine and preparations containing casein peptone and proteose Occasionally these give transitory symptomatic relief

Eradication of Foci of Infection —It was inevitable that the advocates of focal infection should apply their theories and practices to the treatment of osteo arthrosis It would be impossible to estimate the number of teeth and tonsils that have been sacrificed on the altar of this misconception We are unutterably opposed to any attack on infected areas unless for local indications it is bad judgment to remove infected teeth hypertrophied buried tonsils a gallbladder or an appendix with the hope of significantly affecting the osteo arthrosis It is true that the period of hospitalization may lead to a nonspecific amelioration of symptoms but the fundamental disturbance is not subject to change Similarly we oppose intranasal surgery pelvic operations in the female and prostatic massage and operations in the male if they are done for the relief of the arthropathy

Hyperpyrexia —Fever treatment holds no promise for the relief of symptoms in osteo arthrosis

Climatotherapy and Spa Therapy —The Continental cures were often directed at the relief of rheumatism Europeans were accustomed to visit the spa because the air was dry in order to imbibe the lithia or radio active waters to bathe in the healing springs to bury themselves in sulfurous waters or mud packs and to drink alkaline waters which also contained saline purgatives These practices brought travel trade to the country income to the transportation lines a questionable fame for the cure doctors and a mechanism of escape for the patient

[illegible]
Local heat
Massage

Additional Measures if Symptoms are Persistent
Vitamins A and D in large dosage
Alkalinization
Injection of foreign protein
Removal of grossly infected focus
Course of colchicine
Colon irrigations
Calomel-saline purges
Acidophilus implants
Vaccines
Trial period of bed rest
Roentgen therapy
Climatotherapy
Surgery

Useless Procedures
Avoid red meat and acids
Segregate starches and proteins
High vitamin diet
Lithia water
Iodides

Useless and Dangerous Procedures to be Avoided
Injections of serums
Bee stings
Sulfur
Gold
Cinchophen
Hyperpyrexia

GOUT

Gout is a disturbance of purine metabolism It is characterized by *hyperuricemia* (p 737) of varying degree a deposition of sodium urates about the joints and in the form of *tophi* uric acid *nephrolithiasis* (p 2311) and degenerative lesions of the cardiovascular renal systems *Classical gout* is an extremely rare disease but larval or asymptomatic forms are seen with great frequency when suspected and recognized The disturbance is distinctly *hereditary* and occurs in *males* in the ratio of fifty to one

Etiology—Despite many researches and ingenious hypotheses the etiology and pathogenesis of gout remain a mystery Undoubtedly there is some basic metabolic disturbance which results in an increase in the uric acid content of the blood and a deposition of urates in joints and subcutaneous tissues These changes are associated with increased excretion of uric acid as manifested by kidney stones The listed metabolic abnormalities are unquestionably secondary since the clinical syndrome of gout may be present without the necessary association of any of these and the disease cannot be produced in the relatively normal individual by a mere feeding of uric acid or the elevation of the uric acid content of the blood

Despite present ignorance of the fundamental disturbance in gout many *precipitating factors* are noted Thus acute attacks may be caused by *trauma excessive drinking overeating fatigue emotional excitement operative procedures polycythemia leukemia high fat and ketogenic diet* and the *therapeutic administration of liver extracts ergotamine tartrate*

from osteo arthrosis The modality may be applied as a *hot water bottle* an *electric pad* a form of radiant heat from an improvised *baker* (p 3787) *by arm baths foot baths sitz baths* or by *full tub baths* For reasons that are certainly not clear it has been our experience that moist heat in the form of a bath is most comforting

There is no necessity to add anything to the bath water although many patients favor the introduction of bicarbonate of soda epsom salts tar or the volatile oils

Local heat may also be applied by *diathermy short wave applications* and *infra red irradiation* We doubt whether these modalities possess any advantage that justifies the increased expense and trouble of their application

Before sleep the afflicted joint is often comforted by the application of a flannel or woolen bandage after rubbing on an oil

MASSAGE—Rubbing the afflicted joint is certainly comforting and gratifying Whether the professional masseur accomplishes more than the amateur is debatable and the discussion is best settled in each individual case by the method of trial and error If the patient believes that the expense of massage is justified by the results obtained the practice should be continued On the other hand if finances are at a low ebb the patient or some member of the family can probably effect as much comfort by simple stroking

DIATHERMY—We have not been impressed by the results of diathermy in the treatment of osteo arthrosis As with massage we adopt the attitude that the patient may make a trial of diathermy and continue his treatment if he thinks that the trouble and expense are justified by the results Otherwise the simpler forms for the application of heat will probably be found to be equally efficacious

ROENTGEN THERAPY—Deep roentgen therapy has been advocated by those who specialize in this form of treatment Despite the fact that it is difficult to understand how anything can be accomplished by this modality occasionally the end seems to justify the means It is especially used in radiculitis accompanying osteo arthrosis of the spine

SURGERY—Surgery has very little to offer the patient with an osteoarthrosis As a temporary measure injections of *procaine* often produce instant relief of acute pain

In *malum coxae senilis arthrodesis* may be discussed with the patient who is suffering severe pain and greatly restricted motion He may elect to bargain the few remaining degrees of motion for a completely painless and stable joint Occasionally too with involvement of the knee synovectomy *patellectomy* and the removal of local osteophytes or redundant pieces of cartilage are usefully practiced

Recommended Therapeutic Routine

Reassurance
Low calory diet
Thyroid extract for patients with low basal metabolic rate
Estrogen at menopause
Analgesics if necessary
Rest of affected part (use plaster if necessary)
Corrections of deformities by exercises shoes corsets braces and supports

Disturbances of Epiphyses	
Legg Calve Perthes Disease	In children with adiposogenital syndrome Note limitation of motion Aseptic necrosis of capital epiphysis of femur produces dense x ray appearance in contrast to neighboring atrophic bone (p 2927)
Osgood Schlatter's Disease	Involving epiphysis of upper end of tibia (p 2928) Get x rays and refer to orthopedic specialist
Metabolic Disturbances	
Allergic Arthropathy	Effusion in shoulder or elbow with urticaria Note therapeutic response to epinephrine (p 2878)
Gout	Metabolic disorder of purine metabolism. Note high blood uric acid, tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine (p 2874)
Hyperparathyroidism	Cystic changes in bone hypercalcemia and hypophosphatemia (p 1225) Adenomas of gland demonstrable at operation
Osteo-arthrosis	Metabolic disturbance usually in obese mid dle aged patients with hypometabolism In volvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute com plete therapeutic routine (p 2862)
Osteitis Deformans (Paget s Disease)	Enlargement of skull and bowing of tibias (p 2879)
Scurvy	Bleeding gums and periostitis Therapeutic response to cevitamic acid (p 1120)
Systemic Reticulo-Endothelioses	With cutaneous xanthomas splenomegaly and Gaucher cells obtained by sternal biopsy (p 1133)
Infections and Inflammation	
Gonococcemia	History of venereal infection Isolate organi m from urethra cervix or blood (p 217) Note complement fixation test (p 59) Ther apeutic response to penicillin (p 1106)
Fibromyositis	Particularly of shoulder (frozen shoulder) Normal x rays Occasional dramatic response to procaine injections of trigger area (p 2894)
Prepatellar and Gluteal Burs tis	With swelling of local origin Aspirate area (p 2904) Note effects of procaine in ections (p 2814)
Psoas Abscess	Usually with tuberculous osteomyelit s of the spine (p 2942) Get x rays Avoid aspiration until prepared for excision of sinus tract
Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylo coccemia meningococcemia gonococcemia brucellosis tuberculosis or mycoses Look for pathogen (p 2910) Try anti infective treat ment (p 106)
Infectious Osteomyelitis	Local pain and tendernes Note progressive x ray changes (p 2936) Pathogen isolated at operation

CONTINUED

DIFFERENTIAL DIAGNOSIS OF

Pain and Tenderness in Hips, Thighs, Calves and Legs (Exclusive of Feet and Toes)

Pains in the lower extremities are markedly increased as the result of weight bearing In this respect they are of more significance than upper extremity disturbances since they are a greater handicap to the patient in routine activity See p 2898

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Dislocation of Hip	Leg shortening due to posterior displacement of head of femur Note abnormal mobility at joint Get x rays (p 2978) Refer to orthopedic specialist
Trauma	Contusion of muscles Rupture of quadriceps extensor and plantaris (p 2957) Rupture of semilunar cartilage of knee (p 2962) Loose bodies in knee (p 2962) Pinch of infrapatellar fat pad (p 2960) Fractures dislocations and subluxations (p 2982) Slipping of upper femoral epiphysis (p 3043) Postural strains
Circulatory Disturbances	
Arteriosclerosis	Intermittent claudication in older patients (p 996) Diminished oscillometric readings (p 791)
Embolization	Of main artery with impending gangrene (p 969)
Hemorrhagic Capillary Toxicosis	Cutaneous purpura (p 1121)
Phlegmasia Alba Dolens	Milk leg following pregnancy (p 2604)
Raynaud s Disease	In younger patients Normal oscillometric findings Bilateral involvement (p 1000)
Scurvy	Hemorrhagic periostitis and bleeding gums Therapeutic response to cevitamic acid (p 1120)
Thrombo Angiitis Obliterans	With phlebitis and diminished oscillometer readings Usual history of excessive use of nicotine (p 1029)
Thrombophlebitis and Phlebothrombosis	Of peripheral veins (p 1123) Beware of embolization Consider surgery and use of anticoagulants (p 1050)
Psychogenic Disturbances	In malingering and hysteria (p 1367)
Neurogenic Disturbances	
Anterior Crural Neuritis	Often associated with disease of hip joint
Herniated Nucleus Pulposus	Producing low back pain and sciatic syndrome Get laminogram Consider surgery
Injuries Tumors or Neoplasms of Cord	Make neurologic examination (p 3583) Refer to neurosurgeon
Meralgia Paresthetica	From tight corseting
Tabes Dorsalis	Absent reflexes and pupillary changes Characteristic gold curve of cerebrospinal fluid (p 1464)
Myogenic Disturbances	Particularly myositis ossificans Note calcification in muscles (p 2894)

CONTINUED

bluish red cyanotic appearance the local veins are distended and turgid and the overlying skin is tense and shiny The slightest pressure such as would be normal in the course of an examination produces the most exquisite anguish and the patient is usually quite ready and willing to commit murder if so doing would preserve the sanctity of the part

Whereas podagra is the most publicized manifestation of gout it is not uniformly present and the involved area may be the *instep the heel the ankle the knee or the shoulder* Usually the disturbance is monarticular at least in the beginning and the large joints are affected Careful questioning often reveals the presence of one of the predisposing factors such as trauma excessive food or drink fatigue or worry dietary indiscretion or the administration of one of the possibly causative drug

The acute attacks of gout are often associated with constitutional sign There may be a low grade *febrile reaction* or the temperature may rise a



Fig 6—Acute gouty arthritis of great toe

high as 105° to 106 F Associated with this is a *leukocytosis* and an *increase in the sedimentation rate* The *blood uric acid* figures may be high but this is not necessarily the case nor does the height of the uricacidemia parallel the severity of the affliction

The *course* of the disturbance usually involves a period of disability of three to seven days after which the acute symptoms abate and there is a surprising restoration of the part to complete normalcy The patient then remains symptom free for a variable time after which a *recurrence* is experienced sometimes in the joint that has been originally afflicted but otherwise in different structures Attacks increase in duration and intensity The intervals between the acute episodes become progressively shorter until after a few years the joint is never entirely free from pain

Hench in Cecil Textbook of Medicine

Menmgococcemia	Eruption bacteremia and meningeal signs (p 208) Isolate gram negative coccus from blood or spinal fluid (p 53)
Rheumatic Fever	With serous effusion Therapeutic response to salicylate (p 186)
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine (p 2925)
Systemic Mycoses	Particularly coccidioidomycosis (desert rheumatism) Note positive skin te t (p 499) Attempt isolation of organism from a pirate (p 60)
Syphilitic Osteochondritis	Usually neonatal Positive serology (p 2938) Therapeutic response to penicillin (p 340)
Neoplasms	
Endothelial Myeloma	Arising from shaft of long bones particularly in childhood X rays show onion peel formation about area of bone destruction Refer to orthopedist for biopsy and treatment (p 2836)
Giant Cell Tumors	At epiphyseal ends of long bones X rays reveal multiloculated areas with thinned but unbroken cortex Refer to orthopedist for x ray biopsy and treatment
Metastatic Bone Tumors	Seek primary growth el ewhere in body
Multiple Myeloma	Bence Jones proteosuria Myeloma cells in mears obtained from ternal marrow (p 1126)
Osteochondroma	In young persons X rays reveal osseous mass arising from cortex Refer to orthopedist for biopsy and treatment.
Osteogenic Sarcoma	Usually involving shoulder X rays reveal osteogenic and osteolytic activity with invasion of soft tissues Refer to orthopedist for biopsy and treatment
Osteoid Osteoma	X rays show central area of diminished density and surrounding zone of bony sclerosis Refer to orthopedist for biopsy and treatment.

or the *mercurial diuretics* Whereas it is easy to understand why blood disturbances characterized by an increase in nuclear metabolism should produce gout in the susceptible individual it is less clear why this relationship exists with regard to alcohol fatigue and trauma

Clinical Manifestations—Gout may appear in the classical podagrous form but is more often larval and atypical

Podagra—In its typical form which is rarely observed clinical gout begins acutely with increasing *pain* and *tenderness* that usually involve the metatarsophalangeal joint of the big toe (podagra) The pain is excruciating and has been likened to a rat gnawing at the bony structures For some unknown reason it is usually worse between the hours of two and four o clock *in the morning* and is often noted first when the patient arises from sleep The afflicted area appears tense and swollen It has a

Roentgenographic evidences do not appear until the chronic phase of gout has been reached Then *punched out areas of erosion* due to the formation of osseous tophi are noted Films of the kidney region may be misleading since uric acid calculi are not radiopaque

Larval or Atypical Gout—Aside from classical gout the disturbance appears in a larval or atypical form Those who limit the concept of gout to classical podagra find the disease a rare clinical experience The enthusiasts for the importance of disturbances in uric acid metabolism regard all forms of skeletal disability as minor manifestations of gout and perhaps suffer from the inclusiveness of their definition Our attitude is intermediary and is determined not by any preconceived notion but by the *therapeutic test with colchicine* It is our custom to interpret as a manifestation of gout any skeletal osseous articular muscular fibrous or



Fig 39—Two tophi on ear

periarticular disturbance that is alleviated by adequate dosages of colchicine Entertaining as we do a high index of suspicion relative to the importance of gout in obscure disorders of the structures of support and locomotion we encounter symptoms and manifestations relieved by this specific drug in a reasonable number of our patients Hence we count ourselves among those who regard larval or atypical gout as a relatively common affliction

Diagnosis—The positive diagnosis of gout is established when the characteristic needle like *sodium urate crystals* are isolated from small subcutaneous *tophi* When this sign is present *there can be no doubt as to the diagnosis*

A presumptive diagnosis is established in chronic gout when the *x rays*

since the complete type of recovery noted at first gives over into a more or less *chronic inflammatory state*

The *end result* is the appearance of a chronic gouty arthritis with the formation of *subcutaneous tophi* usually noted in the lobes of the ear over

	First Stage (3-42 yrs average 11.7 yrs) Stage of Acute Recurrent Arthritis with Complete Symptomatic Remission (Variations in frequency, duration and severity of subsequent attacks not indicated)		Second Stage Stage of (symptomatic) Chronic Arthritis	
Arthritis			Residual joint disease	
	Phase 1 Early attacks of acute recurrent arthritis	Phase 2 Later attacks of acute arthritis but still with complete remissions	Phase 3 Early active chronic arthritis with acute exacerbations	Phase 4 Late, relatively painless inactive residual arthritis
Hyper-uricemia	In attack + or 0 (often transient) Between attacks 0 or +	Generally but not always + (established)	Almost always ++ but occasionally 0	+ to ++
Tophi	Generally 0, occasionally +	+ or 0 often 0	Generally + Occasionally 0	Almost always + often ulcerating

Fig 737—The basic pattern of gout and gouty arthritis (untreated) *



Fig 738—Area of erosion (tophus) distal end of proximal phalanx of great toe †

the elbows or knees, and of a *deforming arthritis* involving the great toe the knees and the elbows At any time during this disease uric acid calculi may be passed in the urine and eventually *arteriosclerotic phenomena* are observed together with evidences of *renal insufficiency* (p 2275) resulting from the combination of the arterial and calculous diseases

* Hench P S J Lab and Clin Med., Oct 1936

† Hench, in Cecil A Textbook of Medicine

the patient develops the toxic manifestations of nausea abdominal cramps or diarrhea Patients vary in their responses to the drug the sensitive may be disturbed by as few as six doses whereas the more refractory may take upward of twenty doses Because of the laxative effect of colchicine we do not favor the use of the *salines* or *castor oil* at the onset of the attack

The *diet* throughout should consist of the simplest dairy products such as milk and dairy cheeses with cereals starches toast and weak tea As soon as the acute distress has terminated the diet is increased as in the interval treatment

Interval Treatment—Following the subsidence of the acute gout an effort is made to work out a course of prophylactic therapy If the history reveals predisposing and exciting causes the patient is warned to eliminate them wherever possible It is our belief that the use of alcohol in any form is harmful and the patient should be urged to become a *total abstainer*

LOW PURINE DIET

The following list of foods (Table 151) shows the relative purine content of the common dible Those foods in Lists I and II should be avoided in the diet the substances in List III should be chosen sparingly and those in List IV may be eaten freely The total caloric intake is best reduced to 10 to 15 per cent less than the calculated *requirement* It may be necessary to supplement the diet with artificial vitamin B

Type Diet

BREAKFAST

Fresh fruit
Cereal (List IV)
Bread (List IV) and butter
Eggs
Milk

LUNCHEON AND DINNER

Soup (List IV)
Meat Fish and Poultry (List III Part 1 List IV)
Vegetables (List IV)
Dessert (List IV)
Beverages (List IV)

TABLE 151—PURINE CONTENT OF CERTAIN FOODS

List I *Foods which contain very large amounts* (150–1000 mg) of purine bodies in 100 gm

Sweetbreads	825 mg	Kidneys (beef)	200 mg
Anchovies	363 mg	Brains	195 mg
Sardines (in oil)	95 mg	Meat extracts	160–400 mg
Liver (calf beef)	233 mg	Gravies	

List II *Foods which contain a large amount* (75–150 mg) of purine bodies in 100 gm

Bacon beef calf tongue carp chicken soup codfish duck goose halibut lentils liver sausage meat soups partridge perch pheasant pigeon pike plaice pork quail rabbit, sheep shellfish squab trout turkey veal venison

List III *Foods which contain a moderate amount* (up to 75 mg) of purine bodies in 100 gm

Asparagus bluefish bouillon cauliflower chicken crab eel finnan haddie ham herring kidney beans lima beans lobster mushrooms mutton navy beans oatmeal oysters peas salmon shad spinach tripe tuna fish whitefish

Also whole grain bread and breadstuff graham bread graham crackers oatmeal crackers rye bread Rye krisp whole wheat bread Zed

Also whole grain cereals Bemax bran bran flakes cracked wheat Embo graham porridge Grapenuts krumbles malt breakfast food Pep bran flakes Pettijohn, Puffed wheat Ralston s Shredded Wheat, Wheaties Wheat oats Wheatsworth Whole Wheat krumbles

reveal the characteristic punched out areas of erosion These are usually in a juxta articular zone in relation to the afflicted area Presumptive evidence of gout is also afforded by an elevation of the *uric acid content of the blood* (p 737) This finding may be absent during the first attacks but in chronic gout there is always uric acid in excess of 6 mg and the figure may rise as high as 10 to 15 mg per cent

Our reliance as previously stated is often placed on the *therapeutic test with colchicine* While it is true that nongouty phenomena are often alleviated by the administration of the drug the test nevertheless has considerable value and usefulness The differential diagnosis of *gout fibrositis osteo arthrosis* and *rheumatoid arthritis* appears elsewhere (p 2862)

Treatment—The treatment of gout involves the relief of the acute symptoms and the prevention of recurrent attacks

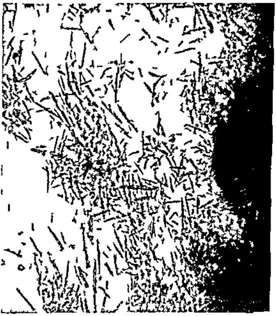


Fig 740 —Urate crystals from gouty tophus (× 435)

The Acute Attack —Since the gouty patient is usually irascible and his torment is acute it is essential to give him immediate relief and the physician should be prepared to give an *opiate* by hypodermic When the acute pain has subsided somewhat the patient is urged to initiate local treatment Hot or cold *wet compresses* are applied with great gentleness The affected joint is *cradled* and protected from trauma During the period when the wet dressings are interrupted a *flannel dressing* is gingerly applied or *heat* is provided from a lamp or a baker

The patient is urged to drink large quantities of *alkaline fluids* in order to prevent the precipitation of uric acid crystals in the renal passages The dosages of *colchicine* are started as soon as the drug can be obtained It is our practice to give 1/100 or 1/120 grain (0 0006 or 0 0005 gm) every two hours during the day and at four hour intervals during the night until

* Hench in Cecil A Textbook of Medicine

Myositis Ossificans Progressiva Generalisata	Widespread deposition of calcium in muscles and fascia Lime depositions observed by x ray Condition slowly progressive May terminate fatally due to intercurrent infection (p 2894)
Osteogenesis Imperfecta	Fragilitas ossium or brittle bones Congenital and perhaps hereditary disorder with thinning of cortex and atrophy of trabeculae Multiple pathologic fractures blue sclerotics and im pairment of hearing (p 2798) Treatment with calcium and vitamin D ineffectual but worthy of trial
Osteitis Deformans	Paget s disease of bone (p 2879)
Osteopetrosis	Marble bone or Albers Schonberg disease Diffuse density of skeleton due to marked thickening of cortex and narrowing of medulla May be associated with pathologic fracture and myelophthisic anemia (p 1091)
Osteopoikilosis	Limited areas of increased bone density noted by x ray Differentiated from multiple myel oma and metastatic carcinoma by lack of progre sion
Psoriatic Arthropathy	Other evidences of dermatosis May be a sociated with joint involvement particularly of terminal interphalanges (p 3414)
Renal Dwarfism	Inhibition of growth hormone As result of uropathy with profound renal insufficiency in the newborn (p 693)
Xanthomatosis	Infiltration of long bones with lipoid in Gauch er s di ease (p 1133) Of cranium in Hand Christian Schuller syndrome (p 1135)

any calorigenic substances The enthusiasts of vitamin therapy suggest the oral administration and intravenous injection of *thiamine chloride* and cer tainly these can do no harm but seem to exert no specific beneficial effect

PAGET S DISEASE (OSTEITIS DEFORMANS)

Paget s disease is a chronic disease of the bone of unknown etiology affecting individuals in later life There is a thickening and bowing of the cortex of the long bones of the lower extremities and the skull Occasion ally the process is limited to a single bone or an area of a bone For ex ample only a small section of one of the pelvic bones may show the changes at first There is also a coarsening and loss of the normal tra becular arrangement *Pathologic fractures may occur* Microscopically the bone marrow is replaced by a vascular fibrous tissue with areas of osteoid tissue and disordered trabecular arrangement The *serum phos phatase* is usually increased but calcium and phosphorus concentrations are normal

Clinical Manifestations—The earliest signs of Paget s disease may be diffuse *pain in the involved bone* most often noted at night It may be associated with a progressive *bowing of the tibias Involvement of the skull* is frequent as evidenced by progressive increase in hat size There may be an associated *kyphosis of the spine* The disease is chronic slowly

DIFFERENTIAL DIAGNOSIS OF

Metabolic Osteo arthropathies

In addition to osteo arthropathies due to avitaminoses endocrinopathies disturbances of purine metabolism and the decrescent syndrome of osteo-arthrosis the practitioner encounters occasionally a symptomatic or descriptive osteo arthrosis essentially of academic interest since therapeutic endeavors are for the most part mere gestures

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Achondroplasia
Chondrodystrophia foetalis With dwarfism due to congenital disorder of ossification. Premature union of epiphyses Extremities shortened in contrast to relatively normal torso Forehead broad Nose flat Mentality and sexuality normal (p 693)

Ateleiosis
Idiopathic symmetrical dwarfism (p 1164) Probably due to deficiency of anterior pituitary growth hormone

Allergic Arthropathy
Serum sickness associated with joint swelling and effusion in 20 per cent of all instances Subsidence complete within one week (p 2878)

Coliform Arthropathy
Chronic non specific ulcerative colitis associated with rheumatoid like arthritis in 5 per cent of patients (p 1856) Joint deformities may persist after bowel condition has subsided

Dyschondroplasia
Multiple cartilaginous exostoses as manifestation of hereditary disorder of osteogenesis Multiple osteochondromas develop at extremities of long bones due to persistent activity of parts of epiphyseal cartilage left behind in shaft Tumors continue to grow until maturity and produce no symptoms other than local pressure

Hemophilic Arthrosis
Repeated hemarthroses usually of knee In hereditary bleeding diathesis Marked by prolongation of coagulation time (p 1118) With destruction of cartilage ankylosis may develop Treat by immobilization and pressure bandage Avoid aspiration

Hypertrophic Osteo arthropathy
Clubbing of fingers and toes In association with chronic cardiopulmonary disturbances (p 962)

Intermittent Hydrarthrosis
Recurrent effusions usually into the knee Of unknown etiology Recovery complete between attacks

Leontiasis Ossium
Generalized thickening of bones of head. Production of lion like facies May be secondary to chronic periostitis or osteomyelitis associated with sinus infections (p 2125)

Melorheostosis
A flowing hyperostosis resulting in x ray appearance resembling the dripping of candle wax

CONTINUED

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Clinical Manifestations.—The earliest signs of Paget's disease may be diffuse *pain in the involved bone* most often noted at night. It may be associated with a progressive *bowing of the tibias. Involvement of the skull* is frequent as evidenced by progressive increase in hat size. There may be an associated *kyphosis of the spine.* The disease is chronic, slowly

progressive and may last for decades In itself it does not lead to a fatal termination but it is frequently complicated by the onset of *osteogenic sarcoma* in the involved bone or *carcinoma of the ovary* The reason for these associations is not clear

The diagnosis is confirmed by the elevation of the blood phosphatase and the typical radiographic picture

There is no *treatment* for the condition itself Useless measures include administrations or injections of calcium parathyroid extract estrogen androgen vitamin D and roentgen therapy Encouraging reports have been made regarding the control of pain by the use of a low calcium low potassium and high magnesium diet with which we have no experience



Fig 742 —Marble bones Roentgenogram of the lumbar vertebrae and pelvis reveals marked increase in the radiographic density of the bones *



Fig 743 —Marble bones Lateral roentgenogram of the lumbar vertebrae reveals homogenous increased density of the vertebrae

THE MUSCULAR DYSTROPHIES AND ALLIED DISORDERS

The muscular dystrophies constitute a miscellaneous group of afflictions some of which involve the muscle tissue in others the primary disturbance is in the neuromuscular end plate or the nerve ending

Pseudohypertrophic Muscular Dystrophy (Progressive Muscular Dystrophy Primary Myopathy) —Pseudohypertrophic muscular dystrophy has a familial incidence and appears almost exclusively in *young boys* The first symptom is an apparent hypertrophy of the affected muscle often in the calves

* Ghormley Orthopedic Surgery Thomas Nelson & Sons

or shoulder girdle An accompanying *weakness* may be noted which later becomes progressively more marked The patient stands with an increased lumbar lordosis and protuberant abdomen due to abdominal weakness

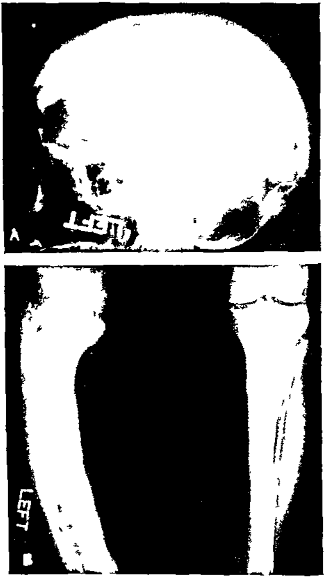


Fig 744—Paget s disease of the skull and tibia In this case (the patient was seventy eight years old) the blood phosphatase was 23 units the blood calcium was 10 7 mg per 100 cc and the blood phosphorus 4 6 mg per 100 cc *

There is a *waddling gait* and *easy fatigability* A characteristic sign is the patient s inability to arise from a recumbent position without climbing up

DIFFERENTIAL DIAGNOSIS OF

Disturbances of Muscle

The muscle mass of the body may respond to a wide variety of systemic disturbances Responses may include hypertrophy atrophy rigidity and spasms fibrillations and twitchings tics and tremors

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Hypertrophy	*Physiological from use Pseudohypertrophy* with weakness In primary myopathy (p 2880)

Atrophy

Arthropathies	Particularly rheumatoid arthritis Vasomotor instability increased sedimentation rate atrophic changes and ankylosis in younger patients
Disuse	Localized or generalized in prolonged infections cachexias and malignant disease
Myopathies	Without significant changes in sensorium or reflexes No reaction of degeneration Note response to neostigmine in myasthenia gravis and to quinine in myotonias (p 2886)
Neuropathies	Peripheral neuritis With reaction of degeneration (p 1641) Transverse myelitis without reaction of degeneration. Chart sensory and motor status (p 1457) Consider consultation with neurologist.

Rigidity and Spasms

Physiologic	As result of cramp strain or prolonged immobilization in an awkward position
Pharmacodynamic	Overdose with strychnine (risus sardonicus) or caffeine
Myogenic	Myoclonus and paramyoclonus multiplex of congenital origin. Myotonia with therapeutic response to quinine (p 2886)
Neurogenic	
Epilepsy	With grand or petit mal Note characteristic electro-encephalograms Therapeutic response to dilantin and phenobarbital (p 1517)
Meningeal	Opisthotonus in pyogenic and non pyogenic meningitis Examine spinal fluid by smear and culture for identification of pathogen (p 1462)
Organic Diseases of Brain	Particularly those involving motor pathways and thalamus Check neurologic status Examine cerebrospinal fluid Consult with neurologist.
Postural	*Particularly metatarsalgia* with disturbances of transverse and longitudinal arches (p 3078)
Infectious	
Rabies	History of bite Hydrophobia Start Pasteur treatment (p 439)
Tetanus	With trismus Give antitoxin and penicillin (p 294)

CONTINUED

Vascular	Intermittent claudication in calves of legs Particularly in peripheral arteriosclerosis and thrombo-angiitis obliterans Get oscillometer readings (p 791)
Metabolic	
Alkalosis	From antacid or hyperventilation
Avitaminoses	Particularly of B complex Note therapeutic response to thiamine niacin and riboflavin
Cholemia	Usually with icterus and markedly impaired liver function (p 1953)
Hypocalcemic Tetany	With carpopedal spasm, laryngismus stridulus and accoucheur s hand Note therapeutic response to vitamin D and calcium (p 723)
Pregnancy	Probably due to avitaminosis alkalosis or hypocalcemia Note therapeutic responses to deficient ingredient.
Uremia	With high nitrogenous retention in blood (p 2278)

Fibrillations and Twitchings

Physiologic	As result of prolonged disuse
Toxic	Particularly alcoholism (p 3848)
Metabolic	
Cholemia	Usually with icterus and marked impairment of liver function (p 1953)
Hyperthyroidism	Note elevation of B M R. Therapeutic response to iodide and deracil (p 1197)
Uremia	With marked retention of nitrogenous products (p 2278)
Infectious	
Encephalitid s	Seek other neurologic changes Note alterations of cerebrospinal fluid (p 444)
Syphilis	Particularly general paresis and tabes dorsalis Check gold curve and Wassermann tests on cerebrospinal fluid (p 3734)
Neurogenic	Lesions of lower motor neurone (p 1476) Epilepsy and petit mal with characteristic changes in electroencephalogram (p 1403) Congenital athetosis (p 1415)

Tic and Choreiform Movements

Chorea	Seek other manifestations of rheumatic fever including relative or absolute pyrexia increased sedimentation rate and carditis (p 186)
Friedreich s Ataxia	Congenital disorder Disturbances of mentality bulbar speech and contractures (p 1415)
Huntington s Chorea	Congenital and familial disorder Impairment of mentality and grimacing (p 1417)
Hysteria	Habit spasm (p 1367)

Tremors

Physiologic	After fatigue Following exposure to cold With chills
Psychogenic	Under emotional stress Hysteria Neuros s

CONTINUED

Pharmacodynamic	From overdosage with thyroid extract, amphetamine caffeine or cocaine From excessive amounts of insulin producing hypoglycemia
Toxic	From excessive use of alcohol tobacco barbiturates or cocaine and cocaine substitutes
Congenital	Familial disturbances particularly head nodding Friedreich s ataxia (p 1415) and Huntington s chorea (p 1417)
Senile	Particularly in arteriosclerotics (p 1197)
Hyperthyroidism	*Note elevation of B M R. Therapeutic response* to iodide or deracil (p 1197)
Neurogenic	
Cerebellar	With ataxia nystagmus and past pointing
Disseminated Sclerosis	Coarse tremor Evidences of widespread patchy motor and sensory disturbances Optic atrophy (p 1504) Refer to neurologist.
Encephalitis	May be Parkinsonian History of acute febrile disturbance Look for other motor and sensory signs Get cerebrospinal fluid (p 444)
Friedreich s Ataxia	Congenital disorder Impaired mentality bulbar speech and contractures (p 1415)
Paralysis Agitans	Intention tremor mask facies and disturbances of gait Note response to belladonna (p 1505)
Syphilis	Particularly tabes and paresis Get gold curves and Wassermann on spinal fluid. Start intensive treatment with penicillin (p 340)

his thighs due to weakness of the lumbar musculature This sign may be absent in early cases

The disease is progressive and usually continues to a *fatal termination* at the end of about ten years The immediate cause of death in most cases is an intercurrent respiratory infection Pseudohypertrophic muscular dystrophy is frequently associated with a *Frohlich habitus* (p 1166) and occasionally a *slipping of the upper femoral epiphysis* (p 3043) is associated

Treatment is unsatisfactory Pilocarpine epinephrine and glycine have been used without noticeable success Recently the use of vitamin E (p 629) and vitamin B_6 (p 622) has been reported The results cannot yet be evaluated

Progressive Muscular Atrophy (Progressive Spinal Muscular Atrophy Chronic Poliomyelitis)—Progressive muscular atrophy is a chronic neurologic disorder in which the primary lesion is a progressive degeneration of the anterior horn cells of the spinal cord The usual age of onset is during early adult life The condition involves principally the extremities below the elbows and knees As the name implies there is a progressive atrophy of the muscles without fibrillation This progresses very slowly and may lead to deformities such as clawhand or clawfoot A very frequent type involves the peroneal musculature (*Charcot-Marie Tooth*) The reflexes are diminished

The disease is not responsive to treatment The orthopedic deformity

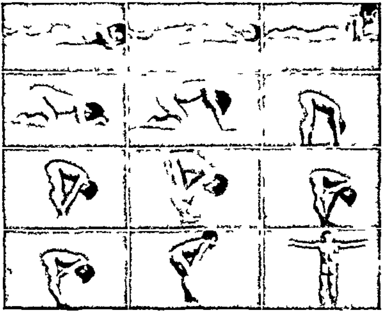


Fig 745 —Pseudohypertrophic muscular paralysis Typical method of rising from recumbent position Note powerful appearing but actually very weak musculature

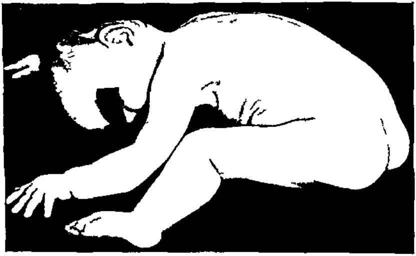


Fig 746 —Amyotonia congenita in a girl sixteen months of age Showing the inability to sit erect.†

may require tendon lengthening or subastragalar arthrodesis Occasionally braces may be indicated

Lewin Orthopedic Surgery for Nurses Including Nursing Care 3rd Ed.
† Griffith and Mitchell, Textbook of Pediatrics

Amyotrophic Lateral Sclerosis (Chronic Anterior Poliomyelitis)—Amyotrophic lateral sclerosis attacks *middle aged adults* and involves the anterior horn cells and the pyramidal tract The condition is characterized by atrophy of the musculature associated with fibrillation and increased reflexes It may start in any region and is rapidly progressive usually terminating in bulbar paralysis after two or three years

No treatment is known Recently *vitamin E* has been claimed to arrest the progress of the disease

Myasthenia Gravis—Myasthenia gravis may occur at any age The affliction is apparently chemical in nature and is a disorder of *acetylcholine metabolism* at the myoneural junction

The principal symptom of myasthenia gravis is *progressive fatigability* This is evidenced by a progressive weakness even unto paralysis which becomes evident after slight use of the muscles Thus the patient can chew a few times only before the masseter muscles are exhausted The fatigability is first evident in the muscles of the face principally the eyes and pharynx *Ptosis* and *diplopia* may occur There may be difficulty in swallowing with regurgitation The symptoms are worse at the end of the day and better after rest Beyond weakness there are no neurologic symptoms The course is remitting with exacerbations

Treatment—The treatment of myasthenia gravis has been revolutionized by the discovery of the efficacy of *neostigmine* The drug may be given orally or by intramuscular injection By mouth the patient is instructed to dissolve a tablet containing 15 mg in a glass of water One third or one sixth of this solution is drunk three times daily If necessary the amount is increased to 150 to 180 mg for the daily dose When the neostigmine is given intramuscularly 1 to 3 cc of the 1 2000 solution are injected three times daily with or without 0 4 mg ($\frac{1}{150}$ grain) of atropine sulfate

The neostigmine treatment may be supplemented by administering 5 gm of *glycine* dissolved in a glass of water after each meal *Ephedrine* in 8 mg dosage ($\frac{1}{8}$ grain) may be taken orally three times daily

If an associated thymoma can be demonstrated surgical excision merits consideration

Myotonia Congenita (Thomsen s Disease)—Myotonia congenita is a rare and interesting familial disease It is generally first apparent *in childhood* and is characterized by a lessened power of relaxation of the voluntary musculature associated with hyperirritability Thus the patient may grasp the examiner s hand and be unable to relinquish it until some seconds have passed Strong emotion and exposure to cold exaggerate this tendency The patient may freeze in a state of tonic immobility and may even fall to the ground The tongue and larynx may be affected

The most striking physical sign is due to the irritability of the muscle On striking a muscle a strong *tonic contraction* is noted which may be accompanied by the formation of a groove or a furrow Rapid repeated tapping of the patellar tendon may result in a tonic extension of the knee which only slowly relaxes

The administration of *quinine* (p 517) results in a marked diminution of the muscular irritability with resultant relief of symptoms The disturbance is at the myoneural junction and is apparently the reverse of that occurring in myasthenia gravis

TABLE 152.—SUMMARY OF THE MUSCULAR DYSTROPHIES

Disease	Age	Pathology	Reflexes	Distribution	Course	Treatment	Remarks
Dystrophies (Pseudohypertrophic)	Young boys 10-12 Familial	Muscular disease with fatty infiltration	Active until late in disease	Axial (hip back, shoulders face)	Progressive Ten years	Non-conclusive Vitamin B_6 vitamin E	Fröhlich type Slipped epiphysis
Atrophies e g Charcot Marie-Tooth	30 years	Anterior horn cells	Lost early	Appendicular atrophy	Many years	None	Often peroneal atrophy Upper extremities may be involved
Amyotrophic Lateral Sclerosis	40–50 years	Anterior horn cells Pyramidal tract	Very active with atrophy and fibrillation Bulbar involvement	May start anywhere	2–3 years	Vitamin E may stop progress	
Myasthenia Gravis	Any age 35 years average	None except possible lymphorrhagia Chemical	Normal but exhaustible No atrophy	Mostly bulbar Worse at end of day	Remitting	Prostigmine is diagnostic and therapeutic test Oral or intramuscular	Usually involves eye and pharynx first
Myotonia (Thomson's)	Early childhood Familial	None Chemical	Normal Marked muscular irritability (Percussion)	Peripheral mostly	Stationary	Quinine	
Myotonia Atrophica	Early childhood Familial	None Chemical	Normal Marked muscular irritability (Percussion)	Peripheral mostly and tongue	Progressive 10-20 years	Quinine	Muscular atrophy Testicular atrophy cataracts tuberculosis
Amyotonia Congenita (Fig 46)	Childhood	Lipomatosis Absence of motor end plates	Diminished or absent	Lower extremities especially	Stationary or improvement	Thyroid extract or quinine	Intelligence normal (Oppenheim's Disease)

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ences nightmares startling reactions to noise and sudden movements and evidences of autonomic imbalance To these are added toxic symptoms resulting from an inordinate use of cigarettes coffee alcohol sedatives and stimulants

Treatment—The treatment of industrial and combat fatigue follows along parallel lines The ability to carry out prophylactic and therapeutic measures depends on the exigencies of the situation Except under unusual stresses industrial fatigue can be prevented to the benefit alike of worker and employer In combat unfortunately men must be driven to a point that seems to exceed human endurance often the consequences involve the victim, his company and command

Prevention of fatigue is accomplished by an intensive program of education and muscle training The working week should not exceed 44 hours except under unusual circumstances The 44 hour week is best constituted as five 8 hour days one 4 hour day and the seventh day as a complete sabbath Each *working day should be broken up* by at least one rest period at luncheon time Monotony may be relieved in factory work that is not too noisy by playing phonograph records or the radio but a constant droning may prove irritating and annoying

Preparations employed to combat or prevent fatigue include alcohol in its various forms tobacco caffeine and its derivatives glycocoll vitamins *glandular* preparations amphetamine *sulfate* inhalations of oxygen and the ingestion of carbohydrates and salts

Alcohol is reputed to prevent and relieve fatigue but its effect is as deceptive as a mirage It masks the recognition of fatigue but does not prevent its occurrence The resultant over fatigue is particularly costly requiring more prolonged rest for adequate recovery

The action of *caffeine* and its substitutes is opposite to the alcohol effect and quite as detrimental The cerebral stimulation impels the individual to apply the whip and drive on past fatigue The widespread use of coffee tea and cola beverages testifies to their reputation as effective measure opposing fatigue The seeming benefits are derived most from the necessary interruption of work required to obtain the drink as well as its fluid and carbohydrate content

Relief of fatigue through *smoking* seems related to interruption of work and a break in monotony In our opinion the effect is psychologic rather than pharmacodynamic

The introduction of *glycocoll* to prevent and treat fatigue has physiologic approval Unfortunately it is therapeutically futile despite the claims of enthusiasts Enthusiasts for vitamin therapy urge the administration of *thiamine chloride* for prevention and treatment of fatigue While the preparation is undoubtedly of value in rare instances of true avitaminosis it is of little value in those with adequate diets

Glandular preparations (thyroid extract epinephrine and adrenal cortical extract) combat fatigue in patients who suffer from specific deficiency syndromes Given to relatively normal individuals they are more likely productive of damage *Amphetamine sulfate* (benzedrine) is widely employed to combat fatigue Undoubtedly its effect is cerebral rather than muscular Prolonged use leads to nervousness tremor insomnia cardiac irregularity or palpitation

Myotonia Atrophica —Myotonia atrophica is characterized by the myotonic symptoms of Thomsen s disease but with associated *muscle atrophy* The lesion is principally restricted to the temporal masseter and sternocleidomastoid muscles but the hands and tongue also may be affected In a fullblown case there is in addition the tetrad of *baldness testicular atrophy cataracts* and *pulmonary tuberculosis* The condition is progressive lasting from ten to twenty years before terminating fatally

Quinine (p 517) results in alleviation of the myotonic symptoms The remainder of the picture is unaffected

FATIGUE AND EXHAUSTION STATES

Fatigue and tiredness indicate temporary states of depression in which adequate stimuli fail to evoke satisfactory responses Fatigued muscle *nerve or brain is* capable of better performance under improved circumstances Exhaustion is a more inclusive term which indicates a state of utter motor and mental fatigue

The Physiology of Muscle Fatigue —Stimulation or contraction of muscle fibers is initiated by nerve impulses Acetylcholine liberated from terminals of motor nerves produces muscle contraction Following successful contraction the kinetic agent is destroyed by cholinesterase an enzyme Cholinesterase in its turn is pharmacologically inhibited by drugs of the physostigmine group

The chemical mechanisms of motor contraction and stimulation are best illustrated in myasthenia gravis (p 2886) In this disturbance the symptoms result from excessive enzymic inactivation of acetylcholine A specific beneficial result follows inhibition of the inhibitory enzyme through the administration of physostigmine Beyond neurochemical mechanisms the metabolism of muscle contraction is dependent also upon systemic factors such as an adequate local supply of oxygen carbohydrate adenylic acid glycogen inorganic phosphate and creatine Temporary deprivation of any of these substances may lead to fatigue

Industrial Fatigue —Industrial fatigue results from iteration of movement from general monotony of work and from failure to observe sufficiently long periods of rest to permit recovery Scientific industrialists have learned that fatigue is accompanied by technical errors and an increased *hazard of accident They favor shorter working hours* interpolated periods of rest and provision for variety in manual procedures Fatigue occurs most readily at higher temperatures and in humidities close to saturation Inadequate lighting objectionable noise fumes and dust contribute to fatigue

Physiologic methods for the prevention and treatment of fatigue include muscle training a work week that does not exceed 44 hours the interpolation of rest periods and avoidance of monotony Speed up procedures are unprofitable in the long run though they may serve the purposes of an immediate exigency

Treatment —See p 2889

Combat and Operational Fatigue.—Combat or operational fatigue results from the incredibly severe stresses and strains that are imposed by modern warfare In addition to disturbances of muscle the sufferer experi

Macrocytic Hyperchromic Anemia	Prolonged period of weakness preceding blood changes in pernicious anemia. Note therapeutic response to liver extract (p 1089)
Microcytic Hyperchromic Anemia	With low color index. Look for bleeding and other causes. Consider therapy with hematinic or transfusion (p 1085)
Myopathies	
Myasthenia Gravis	Fatigue easily induced by repeated movements. Note therapeutic response to neostigmine (p 2886)
Pseudohypertrophic Muscular Dystrophy	In young boys. Increased muscle volume with progressive weakness terminating fatally within ten years (p 2880)
Progressive Muscular Atrophy	In young adults. Below elbows and knees. Progressive atrophy with diminished reflexes (p 2884)
Amyotrophic Lateral Sclerosis	In middle-aged. Atrophy of muscles with fibrillation and increased reflexes (p 2886)
Myotonia Congenita	In childhood. Inability to relax after muscle contraction. Note therapeutic response to quinine (p 2886)
Myotonia Atrophica	As myotonia congenita but with associated atrophy of muscle. Note therapeutic response to quinine (p 2888)
Neoplasm	Particularly silent malignancies of stomach or colon. Look for blood in stools (p 3727). X ray after barium meal and enema
Helminthiasis	Look for ova and parasites in stool (p 1899)

The ingestion of *carbohydrate* and *salt* is mostly encouraged by professional athletes and their trainers. Football players and distance runners eat chocolate for its hyperglycemic effects. Workers in the heavy industries who lost salt through perspiration avidly ingest sodium chloride. The use of these physiological substances is incredibly advantageous in arduous labors as well as in the relatively sedentary who lose electrolyte merely perspiring in the sun.

Exhaustion.—The exhaustion state usually combines mental and physical fatigue. It is a frequent clinical condition increasingly observed with the complexity of civilized existence.

The exhaustion state may follow excessive strain but it also occurs in sedentary individuals sometimes in inverse proportion to the amount of work performed. Coddled women of the mollusc type embrace the exhaustion state with great avidity. Seemingly the less responsibility and the fewer demands made upon them the more easily they become exhausted. Indeed a form of successful therapy includes insistence upon muscle exercise.

Clinical Manifestations.—The clinical symptoms and physical findings accompanying exhaustion are infinite. There is usually an increase in deep reflexes, hypotension, nervousness, irritability, insomnia, headache, myalgia and constipation. Sooner or later each of these symptoms is diagnosed as a separate disease. The patient is labeled "neurasthenic" or "hypoten

DIFFERENTIAL DIAGNOSIS OF

Asthenia

Generalized asthenia is a symptom that is not infrequently encountered It must be differentiated from fatigue tiredness and exhaustion (p 2891) These last are temporary physiologic states resulting from excessive demands on the human economy In the table which follows attention is focussed on generalized asthenia as a main presenting symptom The present concern is not the complaint of weakness that is encountered in the course of almost every prolonged infectious wasting or metabolic disease

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Physiologic	Merely the result of inactivity
Psychogenic	Particularly in hysteria and the neuroses. Consider psychiatric consultation
Congenital Universal Asthenia	Glenard s disease Gastrovisceroptosis nephroptosis vasomotor instability hemorrhoids varicose veins varicocele hypoplasia of the uterus and infertility
Endocrinopathies	
Adrenal Cortical Deficiency	Hypotension and pigmentation of mucous membrane (p 1673) Note therapeutic response to sodium and adrenal cortical extract
Anterior Pituitary Disturbances	Acromegaly (p 1156) giantism (p 1155) adiposogenital syndrome (p 1166) and Simmonds disease (p 1169) Get x ray of sella turcica and refer to neurosurgeon
Diabetes Mellitus	Glycosuria and hyperglycemia Note therapeutic response to insulin (p 1246)
Hyperthyroidism	Elevation of B M R Therapeutic response to iodide and deracil (p 1197)
Hypothyroidism	Cretinism or myxedema with therapeutic response to thyroid extract (p 1191)
Systemic Infections	
Brucellosis	With relative or absolute pyrexia Check brucellergin reaction (p 314)
Influenza	Protracted period of post influenzal depression and asthenia despite normal temperature record and physical examination
Rheumatoid Arthritis	*Inflammatory disturbance* usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine
Tsutsugamushi Fever	Prolonged period of depression and asthenia in convalescence despite normal temperature record and phy ical examination (p 381)
Tuberculosis	With relative or absolute pyrexia Get chest x ray Do tuberculin test Examine sputum gastric content or stool for tubercle bacilli (p 252)
Diseases of Blood	
Leukemia	Prolonged period of weakness with only minor changes in blood spread. Get marrow smear (p 1100)

CONTINUED

Macrocytic Hyperchromic Anemia	Prolonged period of weakness preceding blood changes in pernicious anemia Note therapeutic response to liver extract (p 1083)
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sive or she is said to suffer from chronic rheumatism, poor circulation,' a forme fruste of an endocrinopathy nervous indigestion or mucous colitis Audition of the catalogue of ailments and treatment of the superimposed anxiety neurosis constitute a full time job for any practitioner

Diagnosis—Exhaustion may herald many definitive functional and organic disorders On this account the practitioner is urged to review the differential diagnosis of asthenia (p 2890) and conduct the examinations required to eliminate the listed causes Every so often to test the mettle of the physician the victim of exhaustion may develop superimposed chronic disease In consequence the diagnosis of exhaustion is always tentative In the presence of persistence of symptoms the physical examination should be repeated many times lest a hidden malignancy a low grade infection or an occult blood disturbance be overlooked For example the symptom of asthenia may precede the characteristic appearance of the blood spread in leukemia by as much as a year many patients with obvious malignancy or tuberculosis recall a period of weakness that preceded by a long period the more definitive symptomatology and physical findings

Treatment—When the causes for exhaustion are valid as in the case of an overworked housewife or laborer the practitioner suggests correction of the situational circumstance and the institution of a partial rest cure or vacation Amphetamine sulfate may be used in a supplementary fashion giving a morning dose not to exceed 5 mg Sedation is warranted in the afternoon with a hypnotic at night as a temporary expedient Often salt tablets prove most efficacious Injections of adrenal cortical extract are reserved for obstinate cases but thyroid extract in corrective and maintenance dosage should be given to those who manifest a lowered basal metabolic rate

When office treatment fails to provide satisfactory results a complete rest period or a change of scenery to a spa or a resort may prove highly salutary

The underprivileged who without true cause enjoy exhaustion states soon fall by the wayside In cities they populate the free dispensaries They are a burden to the family and the community Eventually physicians and relatives give up the struggle and the Weary Willies become parasites in the home They may pursue small labors and assume minor responsibility Given an opportunity they become alcoholic or drift into pauperized institutions where they neither spin nor toil

Exhaustion without cause in the pampered is a situation that is dealt with in an unsatisfactory manner with regard to all concerned Sympathy and coddling ingratiate the physician to the patient and perpetuate the disturbance Such a policy constitutes medical prostitution sooner or later it fails except in the hands of the personality doctors Bluntness and truth no matter how gently administered are unpalatable and may lead to the dismissal of the practitioner and the search for solace in cultism mysticism and the current brands of hocus pocus on sale within and without the medical profession

Wealthier patients may gild their infirmities by visiting multiple physicians in the immediate environs Thereafter when home territory has been exhausted they travel far distances to consult more remote

miracle men Eventually they renounce medicine and take up with Christian Science yogi or herbalism Some settle down really to exploit their symptoms With control of purse strings they become addicted to alcohol benzedrine and the barbiturates The Midas influence permit them to interfere in the lives of those sufficiently unfortunate to be under the control of their not too benevolent despotism

CHAPTER 134

THE SKELETAL AND LOCOMOTOR SYSTEMS INFECTIONS AND INFLAMMATIONS

Most commonly infections and inflammations of the structures of support and locomotion are local manifestations of widespread systemic disorders The elective localization of the pathologic entity may be determined in part by the constant trauma to which the skeletal structures and soft parts are subjected The clinical manifestations vary with the tissue affected

Soft Parts—Suppurative lesions of the soft parts are discussed in the section devoted to Minor Surgery (p 3909) Nonsuppurative inflammations usually the result of acute or persistent micro trauma include fibromyositis myositis tenosynovitis bursitis and synovitis which are described in the present chapter

Joint—Inflammatory arthritis which presents many difficult problems to the practitioner must be differentiated from metabolic arthroses such as osteo arthrosis and gout described in the previous Chapter (p 2850) The present concerns are acute and chronic arthritides which are usually metastatic but occasionally result from direct penetration These arthropathies may be of obvious etiology as in a coccal sepsis or they may be of ill defined causation as exemplified by rheumatoid arthritis Involvement may be monarticular (p 2803) or polyarticular (p 2802) The lesion may be sharply confined to articular tissues or it may be associated with one of the osteopathies next to be described

Bones—Inflammations and infections of osseous tissue may attack the growing epiphyses or mature bone Most often epiphysitis appears to result from a disturbance of local vascularity in a child with anterior pituitary dysfunction (p 1152) Adult bone may be involved as the result of pyogenic tuberculous or syphilitic invasion More frequently than formerly was believed osteomyelitis is caused by Br melitensis and the mycoses particularly the ray fungus and coccidioides immitis (p 2930)

FIBROMYOSITIS (FIBROSITIS MYOSITIS MYOFASCITIS MYOGELOSIS)

Fibromyositis is a *nonsuppurative inflammatory process* that involves the *soft supportive tissues* of the musculoskeletal system The changes are localized in the *interstitial fibrous connective tissues* of muscles nerves and subcutaneous structures rather than in the parenchymas of these organs

Fibromyositis occurs at any age and may involve any region of the body It is more prevalent in the adult and more frequent in the male It is met with most often in cold and inclement climates In our opinion *its presence is almost universal* It is doubtful whether any individual goes through life without at one time or another suffering from the effects of the myogeloses

Etiology—Fibromyositis arises from a variety of unrelated conditions including acute *trauma* resulting in the annoying *charleyhorse* This disturbance plagues athletes and spoils most holidays when muscles are put to uses to which they have not been accustomed *Chronic trauma* also causes fibrositis when there are *mechanical imbalances* (p 3054) particularly in the low back the knees or the feet

Fibromyositis accompanies *systemic infections* such as typhoid fever and influenza Less often it is the result of *focal infection* in the teeth tonsils or nasal accessory sinuses The *subcutaneous nodules* of *acute rheumatic fever* (p 186) and *rheumatoid arthritis* (p 2910) are manifestations of fibrositis

The most mysterious etiologic factor in fibrositis is the *neurogenic mechanism* The *frozen shoulder* is seen disproportionately often in patients who suffer from *hyperthyroidism angina pectoris* or *coronary occlusion* It is difficult to figure out an anatomic pathway and a psychogenic mechanism must be predicated since many of these patients are exceedingly tense and highstrung

Pathology—The gross changes in fibrositis are those of *small swellings* or *nodules* in the muscles or subcutaneous tissues The gliding mechanism of fascial and serous surfaces may be impaired Microscopically the inflammation is localized to the fibrous tissues of the intermuscular septa and fascia *Panniculitis* exists when the subcutaneous fat is involved and *periarthritis* indicates changes in the joint capsules The typical *subcutaneous nodules* which often constitute trigger points" consist of cores of granular debris surrounded by fibroblasts

Clinical Manifestations—The clinical manifestations of fibrositis depend upon the nature of the tissue involved When the process is localized in the muscle as in charleyhorse the presenting findings are *pain tenderness* and *limitation of motion* On occasion there may be considerable induration and muscle spasm

When the inflammation is limited to the subcutaneous fibrous tissue definitively palpable *nodules* may be observed as in *rheumatic fever* (p 186) and *rheumatoid arthritis* (p 2910) In the postural strains these nodules are frequently noted over the sacro iliac joints

The *periarticular varieties* of fibrositis are characterized by the production of limitation of motion at times approaching complete *fibrous ankylosis* best illustrated by the *frozen shoulder*' (p 2896)

MYOSITIC TORTICOLLIS

The stiff neck is an extremely common manifestation of fibromyositis The patient usually gives a history of a previous respiratory infection or of sitting in a draught The head is tilted to one side the muscle is spastic and tender and the pain may be excruciating Occasionally this condition is the result of a *subluxation of the articular facets of the cervical spine* (p 2965) under which circumstance the onset is more sudden there is greater difficulty in attempting to touch the ear to the shoulder and sudden relief can be afforded by manipulation (p 2967)

SACRO ILIAC SPRAIN

Fibrositis Involving the Low Back—The muscles of the back are particularly subject to fibromyositis The pain may be diffuse or may be

sharply localized to one of the subcutaneous nodules which serves as a trigger point The local manifestations are not primary but usually result from a chronic postural strain or an infectious process elsewhere in the body

Besides the nodules in the region of the sacro iliac joint *muscle indurations* may be palpable anywhere throughout the posterior spinal distribution The patient complains of sharply defined pain Palpation reveals the indurated structures which on pressure reproduce the subjective distress The pain may be so severe as to suggest a *pleuritis* (p 2219) an *angina pectoris* (p 890) or a *pulmonary infarction* (p 2086)

The *diagnosis* is suggested when the muscle induration is palpable and the physical signs and systemic associations of the more serious conditions are found to be notably absent

FROZEN SHOULDER

Frozen shoulder is a common and painful affliction usually occurring in middle age The pathology is a tenosynovitis of the biceps sheath which may extend into the joint The disease is self limited spontaneous recovery is the rule after a period of time lasting a year or more

The condition usually starts with *pain* which is usually worse at night Motion becomes progressively more limited as evidenced by difficulty in carrying out certain necessary activities such as brushing the hair drying the back and getting the arms into an overcoat Occasionally pain is a minor complaint but more usually it is quite severe

Physical examination reveals considerable tenderness over the biceps groove on the anterior surface of the humeral head Scapulohumeral motion may be completely absent There is often reflex scalenus spasm The radiograph is normal save for disuse atrophy

The *surgical* treatment has not yet been well established Recovery may be accelerated by stretching exercises roentgenotherapy or manipulation under anesthesia

FIBROSITIS OF THE FEET

Patients with weak feet often develop spider web like adhesions within and around the joints These produce pain and limit motion They are often alleviated by *manipulation* which is associated with cracking of the joint It was this simple technic that enabled Locke of Williamsburg Ontario to develop his astounding clinic in a small town in Canada To the circus tent which he used for his operating room thronged hundreds of thousands of rheumatics from all over North America Each patient so far as could be seen was treated by a simple manipulation of the transverse arch which seemingly succeeded in breaking up adhesions in the periarticular tissues

OCCIPITAL FIBROMYOSITIS (INDURATIVE HEADACHE)

It is our opinion that the indurative headache is actually not a cephalalgia but rather a *fibromyositis of the posterior spinal muscles* which find insertions into the base of the skull at the occiput These indurated areas are palpable when the headache is present Often relief can be obtained from *local massage*

DUPUYTREN CONTRACTURE

The Dupuytren contracture is a chronic fibrositis that involves the *palmar fascia* Its etiology is not clear but it may be associated with a *rheumatoid arthritis* (p 2910) There is thickening scarring and contracture of the subcutaneous tissues until the fingers are increasingly drawn into the clenched position with impairment of extension The condition is relieved by excision of the involved palmar fascia

THE FASCIA LATA SYNDROME

A contraction of the fascia lata due to a type of fibromyositis may be the agency for the production of the *low back syndrome* (p 3072) and *sciatic radiculitis* (p 1492) This condition described by Ober is impor

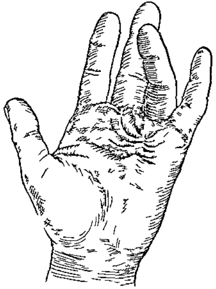


Fig 47—Dupuytren s contracture of palmar fascia causing flexion deformity of ring finger (R drawn from photograph)

tant to recognize since the simple division of the structure gives complete relief to an otherwise intractable and disabling complaint

THE OBER TEST—The Ober test is designed to detect contractions in the fascia lata The patient is placed upon his unaffected side with the lowermost thigh and knee flexed sharply The affected extremity is flexed at the knee flexed and abducted at the hip While the knee is kept flexed throughout the surgeon extends the leg at the hip while maintaining abduction In carrying out this manipulation he keeps a firm grasp on the ankle joint When the hip is in full extension (the knee being in flexion the hip in abduction) the patient is told to relax and attempt to let the knee reach the table (adduct) If adduction of the hip is limited in this position it is due to a contracted fascia lata which may often be felt as a tight band productive of *low back pain* (p 3072)

Lewin Orthopedic Surgery for Nurses Including Nursing Care 3rd Ed

DIFFERENTIAL DIAGNOSIS OF

Pain in the Shoulders and Upper Extremities, Exclusive of Hands and Fingers

Most problems that involve pain in the upper extremities center around the shoulder girdle Few complains offer a challenge so persistent to the practitioner who may be required to exercise all of his ingenuity in order to bring relief to his patient See also p 2954

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Condition	Features
Congenital Anomalies	
Cervical Rib	Pressure by scalenus anticus on brachial plexus and subclavian artery Note changes in peripheral pulses (p 2953) Refer to surgeon for division of muscle
Trauma and Mechanical Disturbances	
Acromioclavicular Separation	Note defect (p 2974) Correct by clavicle splint
Contusions	Of soft parts including muscles and tendons
Dislocations and Fractures	See p 2964 and p 2982 Get x rays in two planes before and after reduction
Hemarthrosis	Of shoulder or elbow Following trauma or in hemorrhagic conditions (p 1118) Get hemogram and check bleeding and coagulation times
Humeral Epicondylitis	Tennis elbow Note pain and tenderness over outer aspect of elbow (p 2963) Observe effects of procaine injection
Rupture of Supraspinatus or Long Head of Biceps	Producing painful shoulder (p 2957) Note relief from procaine injection
Subacromial or Subdeltoid Bursitis	Local tenderness X ray evidences of calcification (p 2901) Attempt aspiration of calcific material and injection of procaine
Subluxation of Radial Head	In children between the ages of 2 and 4 (p 2976) Immobilize after reduction
Tenosynovitis	Dry and stenosing varieties With former note local crepitus (p 2901) Stenosing type observed in flexors of thumbs and fingers
Postural Strain	As in stenographers who sit at work
Psychogenic	Contractures in hysteria (p 1367)
Neurogenic	Injuries inflammations or neoplasms involving cervical cord, brachial plexus or peripheral nerves Check neurologic status Refer to neurosurgeon Tabes dorsalis with absent deep reflexes pupillary changes and characteristic gold curve of cerebrospinal fluid
Referred Pain	
Angina Pectoris	With relief following administration of nitroglycerin (p 890)
Coronary Insufficiency and Thrombosis	Note characteristic cardiographic changes No relief from nitroglycerin (p 893)
Biliary	With cholecystitis, cholelithiasis and gall bladder colic Look for icterus Obtain scout film and cholecystogram (p 2000)

cont

Pleuropulmonary	In association with pneumonia and pleurisy Check characteristic physical signs with x ray findings
Aortitis and Aneurysm of the Aorta	Best revealed by lateral oblique fluoroscopy (p 1026)
Metabolic Disturbances	
Allergy	Producing arthropathy with effusion Usually associated with urticaria (p 2878)
Gout	Metabolic disorder of purine metabolism. Note high blood uric acid tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine
Hyperparathyroidism	Cystic changes in bone Hypercalcemia and hypophosphatemia Adenomas of gland demonstrable at operation (p 1225)
Osteitis Deformans	Paget s disease w th enlargement of skull and bowing of tibias (p 2879)
Osteo-arthrosis	Metabolic disturbance usually in obese m ddle aged patients with hypometabolism. Involvement of spine weight bearing and di tal interphalangeal joints X rays show narrowed joint space lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine
Reticulo-endothelioses	With cutaneous xanthomas splenomegaly and Gaucher cells obtained by sternal biopsy (p 1133)
Scurvy	From deficiency diet. With bleeding gums and periostitis (p 1120) Note therapeutic response to cevitamic acid
Neopla m	
Endothelial Myeloma	Arising from shafts of long bones particularly in childhood. X rays show onion peel formation about area of bone destruction (p 2845) Refer to orthopedist for biopsy and treatment
Giant Cell Tumors	At epiphyseal ends of long bones X rays show multiloculated areas with thinned but unbroken cortex (p 2840) Refer to orthopedist for x ray biopsy and treatment.
Metastatic Malignancy	Seek primary growth elsewhere in body
Osteochondroma	In young patients X rays show osseous mass arising from cortex (p 2835) Refer to orthopedist for biopsy and treatment.
Osteogenic Sarcoma	Usually involving shoulder X rays show osteogenic and osteolytic activity with invasion of soft tissues (p 2843) Refer to orthopedist or biopsy and treatment
Osteoid Osteoma	X rays show central area of diminished density and surrounding zone of bony sclerosis (p 2840) Refer to orthopedist for biopsy and treatment
Multiple Myeloma	Bence-Jones proteosuria Myeloma cells in smears obtained from sternal marrow (p 1126)

CONTINUED

Infections and Inflammations

Fibromyositis	Particularly of shoulder (fro en shoulder) With normal x rays (p 2894) Occasional dramatic response to procaine injection of trigger area
Infectious Arthritis	Of staphylococcal, streptococca' m ingococcal or gonococcal origin Get smears and cultures of aspirate (p 2910)
Osteomyelitis	May be due to penetrating wound or hematogenous sp ead Get blood culture (p 2930 Note progressive x ray changes Start anti infective treatment (p 106) Prepare for surgical intervention
Rheumatic Fever	Serous effusions Usually polyarticular Look for carditis Note increased sedimentation rate and therapeutic response to salicylate (p. 186)
Syphilis	Osteochondritis Usually neonatal Positive serology and therapeutic response to penicillin (p 2937)
Tuberculous	Osteomyelitis with acid fast infection elsewhere in body Usually pulmonary or u inary Note x ray changes (p 2942) Inject aspirated material into guinea pig
Systemic Mycoses	Particu arly ray fungus and coccidioides immitis (p 499) Look for pathogen in a pirate

Treatment of Fibromyositis

Systemic and local measures must be combined in order to deal adequately with the problems that arise in the course of fibromyositis The oral administration of the *salicylates* (p 3832) or the *coal tar preparations* (p 3833) is universally practiced The usual methods of local therapy include *manipulation* the application of *heat* and *massage* with or without the use of a volatile oil such as wintergreen or mustard Accessory assistance is afforded by *bandaging braces* and *supports*

Patients who are suffering acute attacks experience remarkable and dramatic relief when indurated muscle areas or trigger points are injected with *1 per cent procaine* (p 3915) *Manipulative treatment is often* astoundingly successful in conditions characterized by periarthritis These maneuvers undoubtedly have led to the popularity of the schools of osteopathy and chiropracty Roentgen therapy and injections of neostigmine are advocated by enthusiasts but our results have been inconsistent

The compleat practitioner will not rest satisfied with the immediate relief of symptoms He seeks the *predisposing cause* and attempts to eliminate or correct this more fundamental difficulty Thus back and foot disturbances are most often dependent upon *poor mechanics* which demand correction (p 3492) The frozen shoulder' has a background of *hyperthyroidism* or *cardiovascular disease* Lesions about the knee are often the result of the combination of *excessive weight* and *faulty foot mechanics* with *bad shoeing* The occipital headache is commonly seen in those who like stenographers sit at their work with heads bent over Isolated areas

of *myogelosis* in which no mechanical factor can be demonstrated may follow *focal infections* in the teeth tonsils or nasal accessory sinuses

An important therapeutic principle in the periarticular manifestations of fibromyositis is the insistence upon *active motion* and *manipulation* Often these require *procaine injections* (p 3915) *Prolonged immobilization is a genuine menace* and may terminate in disability and deformity

An underlying *rheumatic fever* (p 186) or *rheumatoid arthritis* (p 2910) should be looked for in patients who have febrile disturbances or evidences of a true arthropathy

TENOSYNOVITIS

In addition to suppurative tenosynovitis (p 3975) inflammations of the tendon sheaths are encountered with some frequency

Dry Tenosynovitis —Dry or fibrinous tenosynovitis usually follows excessive use of a tendon This is most frequently found in the *extensor tendons*

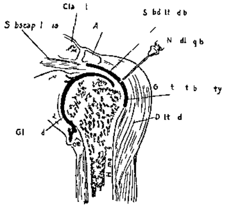


Fig 748—Subdeltoid or subacromial bursitis showing needle puncture for decompressing injecting o la aging the bursa *

of the wrist and thumb and *in the achilles tendon* The *pain* of this condition is quite severe and the diagnosis becomes readily apparent when the dry *crepitating rub* or *creak* is heard or felt as the tendinous structure is put into motion

Treatment requires *immobilization* that must be carried out occasionally for several weeks

Stenosing Tenosynovitis (de Quervain) —De Quervain s disease is a stenosing tenosynovitis of the *long abductor* and *short extensor tendons* of the *thumb* as they pass over the *styloid process* of the *radius* Movement is painful and limited and an operative correction of the disturbance gives prompt and complete relief A pathognomonic sign of this condition is severe pain sharply localized to the tendon when the thumb is folded into the fist and the hand is deviated to the ulnar side

Trigger Finger —The trigger finger is another example of stenosing tenosynovitis The sheaths of the *finger flexors* become stenosed at the

* Modified from Christopher s Minor Surgery and Haldeman and Soto-Hall J.A.M.A 104

point where they cross the *metacarpophalangeal joint* A fusiform expansion of the flexor tendon is generally associated with the constriction of the sheath It is this conformation that gives the characteristic trigger phenomenon in which the patient notes a point of resistance somewhere along the arc of flexion Upon forcing the finger it snaps trigger fashion *past this resistance point and into full flexion* With attempted extension the same procedure is observed

The *treatment* of this condition comprises division of the sheath under local anesthesia The results are excellent

Ganglion —The ganglion is essentially a *saccular evagination* of a *tendon sheath* on the joint capsule The swelling is filled with a mucoid viscid fluid The most frequent localization for the disturbance is on the *wrist* usually the *dorsal aspect*

The etiology of the ganglion is unknown The condition is *benign* it may cause occasional *pain* and *pressure symptoms* The time honored therapy requires a blow on the swelling with the family Bible When the cystic mass is ruptured a *pressure bandage* is applied and this may successfully cure the condition

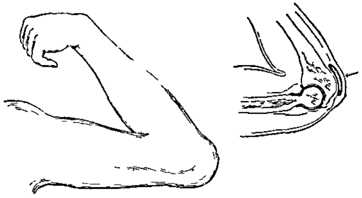


Fig 49 —Bursitis of elbow olecranon bursitis

If there is frequent recurrence the swelling is *aspirated* through a large bore needle The walls are washed out with a 5 per cent solution of *sodium morrhuate* to encourage the formation of adhesions and a pressure dressing is put on for a few days Finally if this procedure is ineffectual *excision* is required

BURSITIS

The bursae are small *synovia lined sacs* which are usually interposed between a *bony protuberance* and the *overlying skin* in sites that are subject to pressure They are also found between adjacent layers of tissue which must slide over each other *as in the subdeltoid bursa* The function of the bursa is to *lubricate* and *protect* the tissues between which it is interposed Because of their vulnerable location they are *frequently traumatized* and give rise to a rather common type of disability

Moorhead, Clinical Traumatic Surgery

Bursitis may be *acute* or *chronic* The acute cases are generally pro duced by some single isolated trauma They are marked by a compara tively rapid outpouring of fluid into the sac which becomes distended Chronic bursitis results from repeated or continuous trauma *Calcified material* is laid down in the overlying structures and within the bursal cavity resulting in severe and often excruciating pain Bursitis is observed in the olecranon prepatellar gluteal achilles subacromial (subdeltoid) and first metatarsal regions (bunion)

Olecranon Bursitis—Olecranon bursitis usually is an acute inflammatory process that results from *trauma* There is an effusion into the sac and the overlying skin may be tense red and warm

A *compression dressing* should be applied but if the disturbance con tinues the sac may be *aspirated* If there is any tendency to recurrence of

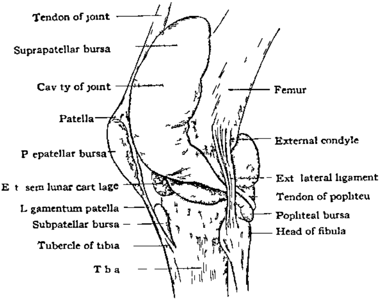


Fig 50—Knee joint structures with se eral bursae distended

fluid a *sclerosing solution* such as sodium morrhuate is injected and a pressure dressing is then applied

Olecranon bursitis is a frequent accompaniment of *gout* (p 2867)

Prepatellar Bursitis (Housemaid s Knee)—Housemaid s knee is an inflam mation of the bursa that lies between the skin and the patella It is usually due to *chronic trauma* as the result of occupations that require *kneeling*

The effusion may be moderate or excessive If a *compression dressing* is not successful *aspiration* and the *injection* of *sclerosing solution* as else where described (p 2433) are necessitated

Gluteal Bursitis—Gluteal bursitis is known as tailor s or weaver s bur sitis since it occurs in those who sit cross legged at their occupation The

swelling is rarely *acute* and *pronounced*. More often it is chronic and causes no particular difficulty. Because of the position of the structure and the danger of *fecal soiling*, aspiration is not recommended unless the disturbance is crippling or incapacitating.

Achilles Bursitis.—The bursa between the achilles tendon and the os calcis is frequently *inflamed* as the result of trauma to the feet due to *bad shoeing* or *imperfect foot mechanics*. This disturbance may cause much *pain* and is best treated by *strapping*, relief of pressure, and proper shoes.

Subdeltoid Bursitis (Subacromial Bursitis).—The most serious and crippling form of bursitis occurs in the subacromial or subdeltoid region. Here the sac is interposed between the *capsule of the joint* into which the tendons of the short rotators are merged, and the overlying *acromion process* of the scapula. In this situation *repeated trauma* occurs from exogenous causes and from misuse of the surrounding structures. There may be an associated rupture of the supraspinatus muscle. *Degenerative changes*

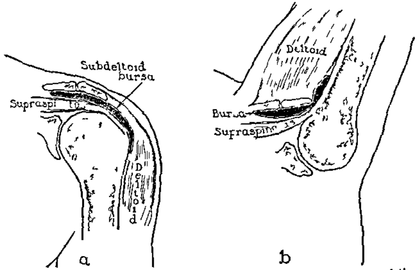


Fig. 751.—Relation of subdeltoid bursa to supraspinatus muscle. *b*, Situation of the bursa during abduction of the humerus.*

occur in the *short rotators* with the deposition of calcium. The calcified material may rupture into the sac where it causes excruciating *pain* and *chronic disability*. *Radiographs* taken in internal and external rotation reveal cloudy deposit of calcific material within and outside the bursa.

Acute subdeltoid bursitis is a self limited disturbance and the symptoms may diminish after several days or a week. During acute stages the arm must be immobilized. Recovery is hastened at times by roentgen therapy and by *aspiration* and *lavage*. The latter procedure is done under local anesthesia; an 18 gauge needle is inserted down to the periosteum of the greater tuberosity; it is then slightly withdrawn and 1 to 2 cc. of procaine are injected and then aspirated. When the deposit is struck, the procaine returns clouded with the chalky material. Without moving the needle, 10 to 20 cc. of the 1 per cent procaine are alternately injected and aspirated until the returns are clear. Following this procedure there may be intense

* Meyerding in Christopher: A Textbook of Surgery.

aggravation of symptoms so that this operation is best done under institutional conditions where the patient may have the relief of hypodermic sedation when required

Eventually in the minority of instances of severe subdeltoid bursitis *operative intervention* by the specialist orthopedist is required since it is necessary to remove the bursa and repair the calcified and degenerated rotator fibers *Physiotherapy including diathermy in our experience has* no specific value

The Bunion (Hallux Valgus) —See p 3977

SYNOVITIS

Synovitis or inflammation of the serous lining of the joint is an integral and inseparable part of any arthritis (p 2905) The term is used to describe any arthritis which is apparently limited to the soft tissue and *shows no roentgenographic evidence of bony or cartilaginous involvement*

INFECTIOUS ARTHRITIS

Infections and inflammations involving the joints create many perplexing *and difficult problems for the practitioner The manifestations may be* those of an *acute subacute* or *chronic invasion* The present discussion deals with the specific forms of infectious arthritis allergic arthritis rheumatoid arthritis tuberculous and syphilitic arthritis

Rheumatism —The concept of arthritis is complicated in the minds of the laity by the fact that it is grouped with the rheumatic afflictions This blanket term is used to include *acute rheumatic fever* (p 186) the specific *infectious arthritides gout* (p 2867) *osteo arthrosis* (p 2855) and the ubiquitous *fibromyositis* (p 2895) The differentiation of these conditions is elsewhere discussed They differ wholly in etiology pathology prognosis complications and treatment

The practitioner does well to avoid the use of the term rheumatism and if employed by the patient its meaning should be clarified

The Specific Forms of Infectious Arthritis —*For the most part the specific* forms of infectious arthritis are encountered in the course of or during the convalescence from a generalized systemic invasion The organisms most frequently involved include the staphylococcus the streptococcus the gonococcus the pneumococcus the meningococcus the typhoid bacillus and the bacteria responsible for Haverhill fever

Pathogenesis —In the majority of instances the infection reaches the joint by a *hematogenous* route Less often an infectious and usually suppurative arthritis is caused by *direct trauma* through a compound wound that communicates externally or through *spread of an osteomyelitis* of the juxta articular structures

Pathology —In the early stages of the arthritis there is a *serous effusion* into the joint. The synovial membranes are hyperemic and there is a marked increase of the cellular elements in the joint fluid The process may be arrested at this stage or it may continue on to the more severe phases of actual joint suppuration Under these circumstances the synovial fluid becomes cloudy and purulent Smears show many polymorphonuclear leukocytes and also reveal the causative organism The purulent joint fluid is *lytic* to cartilage and dissolves the articular surfaces which are affected first and most severely at the points of contact *with the opposing joint surfaces Pannus* a type of vascular granulation tissue, invades

and erodes the cartilage from the sides of the joints The cartilage may become ragged and moth-eaten in appearance In severe instances it disappears almost completely leaving the ends of the bone in apposition When this occurs *ankylosis* is inevitable Adhesions form and join the articular surfaces The infection may then extend into the adjacent bone, resulting in a diffuse *osteomyelitis*

Clinical Manifestations —The clinical manifestations of infectious arthritis vary with the causative organism and the pathogenesis of the affliction In the *traumatic penetrating* types of arthritis there is a clear history of injury followed by manifestations of the inflammatory process In the spread by direct extension the pre existent *osteitis* or *osteomyelitis* becomes complicated by the signs of the secondary arthropathy

In the *hematogenous types* of infectious arthritis the patient notes the onset of pain stiffness and swelling of the joint In most of the infectious forms of arthropathy the *large joints* are involved, notably the *knees ankles shoulders* and *hips* Whereas in most of the coccal infections the distribution is *monarticular* in rheumatic fever the disturbance is more characteristically *polyarticular*

Examination reveals *redness heat* and *swelling* in the involved structure Often the effusion can be clearly delineated most especially in the knees ankles and wrists Associated constitutional manifestations are present such as *fever malaise leukocytosis* and *increased sedimentation rate* Often the onset is accompanied by a *chill* and the *fever* may be of the septic type

In staphylococcal streptococcal gonococcal pneumococcal and meningococcal infections the *blood culture* is often *positive* at the time of the complicating arthropathy A bacteriemia is notably absent in rheumatic fever and often in the gonococcal invasions which sometimes do not become manifest for a considerable time after the onset of the primary local lesion

The most important single diagnostic aid is cultural and cytologic study of fluid aspirated from the inflamed joint Frankly purulent fluids usually yield the organism in smears and cultures Clear fluids such as occur in rheumatic fever are sterile throughout the course of the disturbance

Bacteriologic Variants —The nature of the acute arthritis is often determined by the type of the bacteriologic invader In *staphylococcemias* (p 153) and *streptococcemias* (p 163) an acute suppurative inflammation may be anticipated unless treatment is early and concentrated *Gonorrheal arthropathy* (p 217) is usually more or less subacute or chronic It may not develop until considerable time has elapsed following the acquisition of the infection In females there may be no history or clinical manifestations of any venereal disturbance Bacteriologic investigations yield no significant findings but the *complement fixation tests* are often helpful when positive

The arthritis of *rheumatic fever* (p 186) is *polyarticular* There is severe pain swelling and redness and the symptoms characteristically shift from one joint to the other Despite the severity of the infectious process recovery is usually complete without any significant residual limitation of motion or deformity The therapeutic test with the administration of the *salicylates* is exceedingly helpful in the differential diagnosis

Henoch s purpura (p 1121) is a variety of the rheumatic syndrome it occurs in children in association with gastro intestinal symptoms and *dermatosis* This syndrome is associated with *arthralgia* and actual *effusion* into the larger joints The appearance of the eruption clearly distinguishes Henoch s purpura from other types of infectious arthrit s

Joint swellings are also seen in *Haverhill fever* which is a variety of rat bite fever (p 365) This is probably of spirochetal origin The joint manifestations are not specific but the characteristic *eruption* (p 172) and the epidemic nature of the disturbance suggest the etiology

Roentgenographic Characteristics—The roentgenographic findings are characteristically lacking in the arthritis of true rheumatic fever and the acute stages of the pyogenic invasions Where there is an advance of the

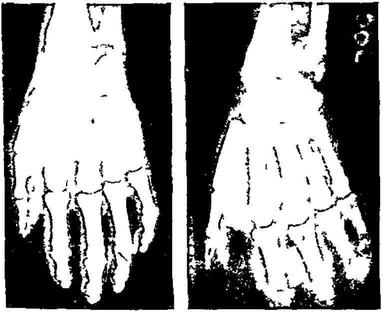


Fig 2—Acute infectious arthritis showing progression of the d sease over a two-week period

inflammatory process towards suppuration the joint spaces appear narrow because of the destruction of the articular cartilage Later the anatomic details become blurred and the osseous complications become increasingly manifest after the first ten days or two weeks

Course—The course of an acute infectious arthritis varies considerably In rheumatic fever the condition subsides without any consequences in the course of one to two weeks The suppurative arthritides in the era that preceded the introduction of the sulfonamides often progressed to complete destruction of the joint surfaces and eventual ankylosis

Gonorrheal arthritis may be fulminating but most often it pursues a *subacute* or *chronic* course resulting in a crippling deformity So materially has the influence of the sulfonamides altered the course of the infectious

DIFFERENTIAL DIAGNOSIS OF

Pain and Tenderness of the Hands, Fingers, Feet, and Toes

Painful afflictions of the hands fingers feet and toes are particularly crippling since the patient is prevented from carrying out routine activities with any degree of comfort or skill

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Traumatic or Mechanical	Contusion or rupture of muscles or tendons. Dislocation subluxation or fracture Get x rays in two positions (p 2982) Weak foot Claw foot (p 3087) Hallux rigidus and bunion (p. 3977) Corns Plantar warts Short heel cord (p 3091) Metatarsalgia (p 3086) Painful heel (p 3090) Scalenus syndrome (p 2953)
Psychogenic	Hysterical contractures (p 1367) Occupational neuroses
Neurogenic	With peripheral neuritis Note motor and sensory changes (p 1476)
Circulatory	
Arteriosclerosis	In elderly Note fundus changes (p 976) Check blood pressure renal function tests and oscillometer readings
Autonomic Imbalance	Moist hot or clammy extremities (p 1395)
Frost Bite	With chilblains and impending gangrene (p 3990)
Erythromelalgia	In young females with vasomotor disturbances. No other demonstrable change (p 1002)
Raynaud s Disease	In adults Bilateral and symmetrical involvement Fear impending gangrene (p 1000) Note relief from papaverin
Thrombo-angitis Obliterans	In middle aged men With phlebitis oscillometric changes and impending gangrene (p 1029)
Thrombosis or Embolism of Peripheral Artery	Note acute pain and loss of peripheral pulse (p 995) Fear gangrene Try heparinization (p 1050) Consider surgery
Trench Foot	With vasomotor disturbances and impending gangrene (p 1002)
Epiphyseal	Freiberg Kohler and Kienbock disease in children (p 2929) Of metatarsals and tarsals scaphoid and carpal semilunars Refer to orthopedist
Infection and Inflammation	
Infectious Arthritis	Usually secondary to systemic invasion in rheumatic fever streptococcemia staphylococcemia meningococcemia gonococcemia brucellosis tuberculosis or mycoses Look for pathogen (p 2906) Try anti infective treatment.
Osteomyelitis	With progressive x ray changes. Give antibiotic and prepare for surgery (p. 2930)

Rheumatoid Arthritis	Inflammatory disturbance usually in pubic adolescents and young adults. Involvement of any and all joints especially spine and proximal interphalangeal. Note pyrexia, increased sedimentation rate, muscle atrophy and vasomotor instability (p. 2910). Institute complete therapeutic routine.
Soft Tissues	Ingrown nails. Paronychia. Cellulitis (p. 3262)
Syphilis	Dactylitis with positive serology. Therapeutic response to penicillin (p. 2937)
Tuberculosis	Dactylitis. Look for other lesions in lymph nodes and lungs. Get skin test or biopsy (p. 2942)
Tenosynovitis	Note grate in dry variety. Increased pain on motion in stenosing type (p. 2901)
Metabolic	
Gout	Metabolic disorder of purine metabolism. Note high blood uric acid, tophi and sodium urate deposits (p. 2867). Try therapeutic test with colchicine
Hyperpituitarism	Large spade hand in acromegaly (p. 1136). Get x ray of sella turcica. Refer to neurosurgeon.
Hypertrophic Pulmonary *Osteo-arthropathy*	Clubbed fingers and toes. Look for cardiopulmonary diseases or subacute bacterial endocarditis (p. 1021)
Hypothyroidism	Spade hand in cretinism (p. 1191). Note therapeutic response to thyroid extract.
Osteo-arthrosis	Metabolic disturbance usually in obese middle aged patients with hypometabolism. Involvement of spine, weight bearing and distal interphalangeal joints. X rays show narrowed joint spaces, lipping and spur formation. Normal temperature and sedimentation rate. No muscle atrophy (p. 2855). Institute complete therapeutic routine
Psoriatic Arthritis	With characteristic exanthem (p. 3416)
Tetany	Carpopedal spasm. Hypocalcemia. (p. 723) Note therapeutic response to calcium and vitamin D
Vitamin D Deficiency	Deformities in infantile rickets and osteomalacia. Note effects of vitamin feeding (p. 2830)
Neoplasm	
Glomus Tumor	Isolated painful neoplasm requiring excision (p. 1435)
Osteoid Osteoma	With x rays showing central area of diminished density and surrounding zone of bony sclerosis (p. 2840). Refer to orthopedist for biopsy and treatment.

arthropathies that there seems no present necessity to describe the harrowing details of earlier experiences

Treatment —The brilliant successes of anti infective therapy have greatly simplified the treatment of the infectious forms of arthritis Whereas

DIFFERENTIAL DIAGNOSIS OF

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The alternative terminology which we have tried to avoid lays emphasis on one or other of the pathologic reactions Atrophic arthritis refers to the final result in the bone ends while proliferative arthritis stresses the changes that occur in the synovial membrane The modifying adjective infectious applies to the apparent etiology Since these terms are all misleading it would seem best in the present state of our confusion to adhere to the label of rheumatoid arthritis

Etiology—The etiology of rheumatoid arthritis is unknown There is much evidence that points to the fact that *the fundamental process is infectious* but the etiologic organisms have not been isolated

There is a widespread impression that rheumatoid arthritis is related in some way to *focal infection* Since this impression first gained currency there has been a wholesale removal of teeth tonsils and other accessible organs without any significant alteration in the course of the disease so that the hypothesis is no longer tenable There is no doubt however but that focal infection may cause an exacerbation of the previously damaged joint, but this mechanism is not the prime motivating force

Rheumatoid arthritis shows a predilection for development in patients of the *ptotic habitus* (p 3190) In contrast to osteo arthrosis (p 2855) which develops in sthenic patients the victims of rheumatoid arthritis are slim and frequently exhibit *postural defects* such as scoliosis knockknees bowlegs disturbances of the back and of the foot

We have become convinced that there is an important *psychosomatic factor* (p 1344) in the origin of rheumatoid arthritis It may be that this is merely of exciting significance but certainly a large number of those who suffer from this disease are young people who give a clearcut history of emotional or situational stress prior to the development of the arthropathy The majority of these patients also manifest the widespread disturbances of the involuntary nervous system which are best classified as *autonomic imbalance* (p 1395) Close questioning reveals that there is an antecedent vasodermal disorder such as hot or cold clammy extremities easy blushing and flushing and manifestations of secretory and motor difficulties particularly in the intestinal tract The practitioner recalls that it is this *triad* of comparative youth autonomic imbalance and psychic maladjustments which appears as a recurrent theme in other more clearly defined *psychosomatic disturbances* such as peptic ulcer nonspecific ulcerative colitis and essential hypertension

Once the disease has become established *exacerbations* often follow *emotional crises* and *prolonged tensions* of one type or another Contrariwise relief of symptoms is often associated with the institution of any therapeutic measure to which the patient wholeheartedly subscribes This latter factor is undoubtedly responsible for the multiplicity of agencies and miracles which are publicized in reference to the management of the affliction

As in most other arthropathies *trauma exposure to cold or damp weather* and *exhaustion* are credited with being etiologic factors and conditions which produce exacerbations Those who are most interested in endocrinology suspect that the disturbance is essentially a *glandular imbalance* but there is no adequate proof for the continuation of the belief *Metabolic factors are also regarded* as causative in rheumatoid arthritis but again

in rheumatic fever the most effectual drug is still the *salicylates* in the other forms of bacterial invasion, *sulfonamides* (p 88) and *penicillin* (p 106) are specific if the disturbance has been caused by staphylococci streptococci, gonococci or meningococci *Streptomycin* (p 104) may be exhibited in bacillary infections such as typhoid tularemia and brucellosis Sulfadiazine may be given orally or parenterally Penicillin and streptomycin are best given by intramuscular injection The treatment routine may combine any two or all three of the antibiotics

Chemotherapy is reinforced by the simultaneous use of *bed rest* a *high calory diet* and a sufficient *fluid intake* It is best to omit all other forms of medication during the period of administration of the specific drugs lest the onset of toxic symptoms such as nausea and vomiting confuse the clinical picture

Local treatment to the joint itself is of symptomatic value Usually it is sufficient to wrap the afflicted joint with cotton and a flannel bandage or it may be enclosed in a large pillow The application of skin traction is a useful form of immobilization Should the condition be refractory to treatment a *bivalved plaster of paris splint* (p 2992) is made to hold the afflicted joint in an optimum position should eventual ankylosis occur

When the pain is severe and the effusion fails to subside rapidly after the institution of specific chemotherapy *joint aspiration* has therapeutic as well as diagnostic value The removal of the cartilage dissolving pus ameliorates the acute symptoms and prevents later disability and limitation of motion The practitioner is warned that joint aspiration requires meticulous aseptic technic If all precautions can be taken and assistance is available the aspiration may be combined with *lavage* using a solution of penicillin (1 cc = 1000 units)

In the obstinate forms of infectious arthritis that fail to yield to sulfonamides *hyperpyrexia* (p 3789) has proved of considerable value particularly in the gonorrheal forms In private practice the febrile reaction may be induced by the injection of *boiled milk* (p 1379) or by *intravenous typhoid vaccine* (p 1379) In well equipped institutions it is induced by the *hypertherms* (p 3790)

Physiotherapy should not be neglected because of the successful use of chemotherapy *Gentle massage* and *active motion* are instituted as soon as pain permits The patient is urged to employ *active motion* in order to minimize the danger of flexion contractures and other types of limitation of motion

The surgical approach to the treatment of infectious arthritis has been reduced considerably by the success of chemotherapy In the acute stages *arthrotomy* (p 2813) was often necessitated by the virulence of the local process and the persistent bacteremia The chronically damaged joints with persistent pain and awkward deformities often required an *arthrodesis* (p 2813)

RHEUMATOID ARTHRITIS (ATROPHIC PROLIFERATIVE OR INFECTIOUS ARTHRITIS)

Rheumatoid arthritis is a *systemic disease* of undetermined origin It is characterized by inflammation of the articular and periarticular tissues leading to *atrophy deformity* and *ankylosis*

Incidence—Rheumatoid arthritis accounts for a very large proportion of the total invalidism in the United States It is estimated that there may be approximately 2 000 000 sufferers in this country alone and there is proportionally a higher percentage in Great Britain where chronic rheumatism constitutes the greatest single factor in terms of economic loss from chronic disease to the Empire

Rheumatoid arthritis is a disease of *young adults* but it may occur at the extremes of the age cycle Whereas there does not seem to be any hereditary trend the affliction is often *familial* probably due to the com mon operation of some one or more of the predisposing factors The dis ease is definitely more prevalent in cold damp climates and relatively in frequent in the tropics and in semitropical regions

Pathology—The pathologic process begins in the *synovial membrane* which early in the disease shows *lymphatic infiltration* and *fibroblastic proliferation* At this stage, *articular effusions* may be noted in which the fluid is clear cloudy or even purulent, depending upon the severity of the process The *capsule* of the joint becomes involved and young granula tion tissue forms in the *synovia* along the margins of the articular cartilage eroding the car tilage as it goes This shelf of granulation tissue is called the *pannus* As the process ad vances the articular cartilage is progressively destroyed leading to a *narrowing of the joint space* as seen in the x rays There is an accompanying *atrophy* of the muscles controlling the joint, which is swollen hot and tender As the process continues the joint cartilage is progressively diminished until at the end stage bone may be apposed to bone leading to *fib ous* or even *bony* ankylosis When the joint is obliterated by bony ankylosis the joint symptoms disappear

The pathologic process may become temporarily or permanently arrested at any of these stages

Clinical Manifestations—The onset of rheumatoid arthritis may be sud den or *insidious* In the *acute forms* a *high fever* with *severe constitutional* symptoms and *multiple joint involvement* develops rapidly The more usual type of onset is *gradual* with *vague joint pain* associated with *stiffness* and *slight swelling* There may be *anorexia malaise* and slight constitutional symptoms with a measurable low grade *pyrexia* The most frequently affected joints are the *metacarpophalangeals* and the *proximal interphalangeals* Later as the disease progresses the larger joints are affected and at this time the febrile process becomes slightly more marked and the sedimentation rate is increased *X rays* in the early stages show only the synovial thickening and the evidences of effusion This phase may continue for months to years and then subside spontaneously or con tinue on to the more severe types

With progression of the process the constitutional features become more marked *Anorexia* is increasingly present There is *loss of weight anemia restlessness insomnia* and persistent *elevation of temperature* which is usually highest in the afternoon

The patient at first ambulatory begins to spend more and more time in bed and soon may be unable to progre s further than the lavatory The affected joints are notably *swollen* and *painful* *Motion* is distinctly limited and associated with severe discomfort The *vasomotor manifestations* are particularly evidenced by the cold clammy hands and feet The sufferer is susceptible to changes in weather and to draughts *Subcutaneous nodules* may be felt or seen *Muscle atrophy* is particularly striking and in the

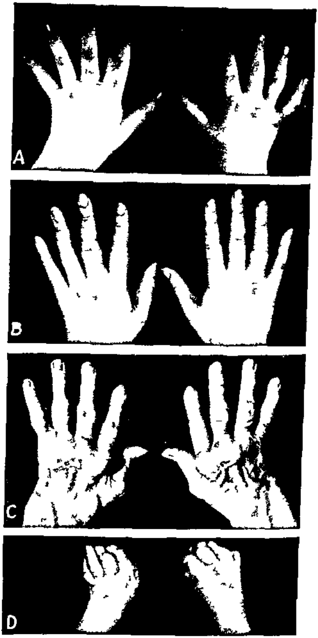


Fig 753*—Stages of rheumatoid arthritis *A* Early involvement in a child *B* Early involvement in an adult Note the fusiform swelling of the fingers *C* Late changes Note the characteristic ulnar deviation of the fingers the flexion deformities the atrophy of skin and interosseous muscles and the persistence of the fusiform swelling of the fingers *D* Late stage with complete crippling deformity This can be prevented by proper splinting in the active stages

there is no adequate proof and measures aimed to correct chemical disturbances have no influence on the course of the affliction

* *A B C* Courtesy of Dr Ralph Pemberton *D* Courtesy of Dr Theodore Bach. From McCombs Internal Medicine in General Practice

of the articular surfaces *Contractures* generally in the direction of flexion become evident The *skin* has a glossy unhealthy appearance

The *course* of the disease is characterized by periods of spontaneous remission and exacerbation These occur at any time and in any stage and may last for days weeks or months or they may even be permanent It is this unpredictable and uneven course that makes the evaluation of thera peutic measures so difficult and probably accounts for the wide variety of suggested cures

In the *final stage* of the affliction the patient is completely *bedridden* and is literally reduced to skin and bones *Contractures* become increas ingly severe and the *deformities* are bizarre and pitiful *Pressure sores* appear over the bony prominences The *joints ankylose* in the most awkward positions *Cachexia* becomes increasingly marked and after a prolonged



Fig 755—Radiograph of spine of a young man with advanced ankylosing spondylitis (Marie Strumpell spine) Notice how the bodies of the vertebrae are fused together by membrane of calcifying fibrous tissue The sacro-iliac joint markings have been obliterated *

period of invalidism death seems a relatively happy solution to a life of increasing anguish

Clinical Variants—Rheumatoid arthritis appears in other clinical forms in addition to the polyarticular variety These include ankylosing spondylitis Still s disease and Felty s syndrome

Rheumatoid Arthritis of the Spine (Ankylosing Spondylitis Marie Strumpell Arthritis)—The Marie Strumpell type of ankylosing arthritis is merely one manifestation of rheumatoid arthritis in which the prominent pathologic involvement occurs in the spine The disease is never completely limited to the vertebrae but there is always an associated involvement of the *sacro iliac hip* or *shoulder joints* although these may be involved later and to a lesser degree

* Cecil A Textbook of Medicine

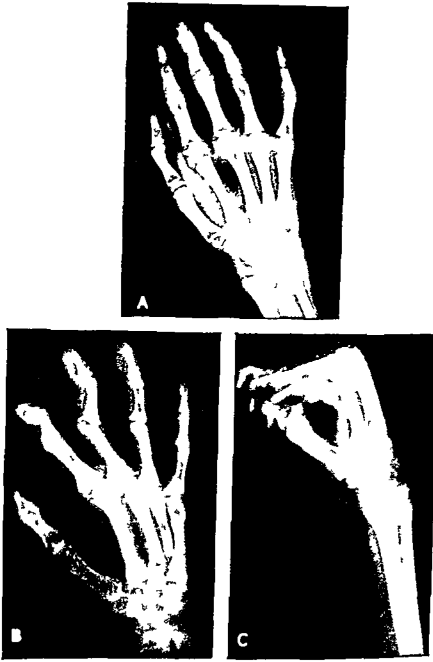


Fig 754.—X rays of the hands in rheumatoid arthritis. *A* Marked atrophic changes in an eight year-old child Note the swelling of the soft tissues about the middle phalangeal joints *B* Late stage showing dislocation and bony ankylosis Atrophy of bone still evident. *C* Late stage showing the marked crippling deformity

proximal interphalangeal joints leads to the appearance of the typical spindle-shaped fingers At this time *x rays* begin to show fairly marked bone atrophy narrowing of the joint spaces and irregularity and clouding

• McCombs Internal Medicine in General Practice

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Ankylosing spondylitis is more frequently observed in *males* The onset is almost invariably *insidious* with progressively increasing sacro iliac pain and limitation of motion of the spine Occasionally the onset is acute when the attention of the patient is drawn to the involved area by *trauma* or *back strain* The *costovertebral* joints are usually involved simultaneously This results in a relative fixation during the respiratory excursions Breathing is of the abdominal type and is often associated with a sensation of compression around the thorax

The *course* of rheumatoid arthritis of the spine is slowly progressive over periods of years There may be occasional remissions and exacerbations but eventually the entire spine is converted into a single bony unit by fusion of the component joints In addition, the costovertebral sacro iliac and hip joints become ankylosed and the patient seems to be constructed out of a single piece of board

The *spinal ankylosis* occurs in flexion and the patient becomes progressively more stooped until finally he cannot raise his head and may even have to recline to drink fluids The steps become smaller and shorter walking becomes so difficult that the only relative comfort that the patient enjoys is reclining in some outlandish position in bed

The *roentgenographic picture* is usually most marked in the sacro iliac joints These reveal the changes of rheumatoid arthritis previously described Eventually there is calcification and ossification of the longitudinal ligament of the spine leading to complete fusion with the appearance of the bamboo spine '

Still s Disease —Still s disease is probably a variation of rheumatoid arthritis occurring in *children* In addition to the arthropathy there is a *splenic enlargement* with *lymphadenopathy* *Effusions in the pleural cavity* are particularly prominent features The child exhibits marked arrest in growth due to alterations in the growing epiphyseal cartilage

Felty s Syndrome —Felty s syndrome is a counterpart in the adult of Still s disease in the child There is an association of the rheumatoid arthritis with *splenomegaly lymphadenopathy leukopenia secondary anemia* and a yellowish brown *pigmentation* of the skin

Associated Conditions and Complications —As if the joint disturbances were not a sufficient cross to bear the sufferer from rheumatoid arthritis is subject to other associated afflictions *Secondary anemia* is almost a constant accompaniment of the disease The intestinal tract never seems to function satisfactorily *Anorexia* is persistent and *constipation* alternates with bouts of *diarrhea* due to a nonspecific colitis This feature together with the fact that patients with nonspecific ulcerative colitis develop a rheumatoid like affliction of their joints has led many clinicians to believe that the two diseases are somehow linked etiologically or at least different manifestations of some common disorder

The *vasomotor neurosis* which is a constant accompaniment often goes on to more serious vascular disturbances The *ischemia* of the fingers becomes so severe that spontaneous amputations occur The skin becomes hidebound and increasingly glossy until the condition of a *scleroderma* is reproduced or at least closely simulated These vascular accompaniments suggest that a similar process originating in the synovia and the other

articular components may be responsible for the beginnings of the disease and its obstinacy referable to therapy

The other serous membranes occasionally become involved *Pleural* and *pericardial effusions* are often encountered and *endocarditis* develops in a fairly high percentage of those who survive the disease for many years suggesting a relationship to rheumatic fever Enlargement of the liver and spleen are rarely noteworthy except in the syndromes which bear the names of Still and Felty Significant lymphadenopathy does not occur and such dermatoses as develop are more likely coincidental or manifestations of *drug dermatitis* (p 3335) The arthropathy of *psoriasis* is probably unrelated to the rheumatoid condition

Laboratory Findings —The laboratory data are of little assistance in the diagnosis or treatment of rheumatoid arthritis In the acute phases there is a *leukocytosis* and usually a *secondary anemia* The *sedimentation rate* is increased and this together with the febrile picture assists in determining the course of the disease and its trend *Cultures* of the blood and joint fluids yield no consistent findings although from time to time it has been reported that streptococci could be isolated

In contrast to osteo arthrosis (*q v*) the *basal metabolic rate* is not consistently lowered nor is there any elevation constantly present Much stress has been laid upon *sugar tolerance tests* (p 3716) which fail to reveal the *normal hyperglycemia after the carbohydrate meal* *The blood chemical findings are otherwise irrelevant* though the *cholesterol figures* tend to be on the low side *Gastric anacidity* is often present but this is also true of many individuals who do not have rheumatoid arthritis

Diagnosis —The diagnosis of rheumatoid arthritis should not present any difficulty It must be differentiated from other afflictions of the skeletal structures such as *rheumatic fever* (p 186) *osteo arthrosis* (p 2855) the specific forms of *infectious arthritis* (p 2905) *gout* (p 2867) and especially *fibrositis* (p 2894)

Rheumatic fever occurs in young individuals Cardiac complications are observed at an early stage The joint manifestations tend to abate within a few weeks and respond to specific therapy The larger joints are more usually involved and often the affliction is monarticular

Osteo arthrosis is an affliction of older persons usually beyond the age of thirty five years The patient is of the sthenic habitus and is usually thickset and often obese There are no constitutional manifestations The *sedimentation rate is normal There is no elevation of temperature* The basal metabolic rate is often strikingly depressed Muscular atrophy is conspicuously absent Vasomotor disturbances are rarely encountered The larger joints are usually afflicted except in the instance of the Heberden s nodes which attack the distal finger joints rather than the proximal interphalangeal structures Effusions are rarely noted unless there is a superimposed trauma There are no inflammatory signs Contractures do not occur

The general health does not suffer and the course of the disease shows little or no progression The roentgenographic picture reveals lipping and the formation of osteophytes rather than the changes of fusion and ankylosis

In the *specific forms of infectious arthritis* there is a precedent or accompanying infection The onset is violent and constitutional symptoms are severe Cultures of joint fluid reveal the typical organism in strepto coccal staphylococcal pneumococcal and meningococcal invasions Gonor rheal lesions are often associated with a positive complement fixation test Usually the arthropathy is monarticular and the response to sulfonamides is specific and rapid with reasonably complete recovery in the local in flammatory area

Gout should offer no difficulty in diagnosis in the acute phases the onset is violent there may be the characteristic podagra, the response to *colchicine* is almost specific and restitution to normal occurs in a short time In the later stages of chronic deforming gout the blood uric acid figures are usually elevated tophi are demonstrable and the characteristic crystals can be obtained from the subcutaneous deposits

Fibrositis is not associated with constitutional symptoms Pain is often increased by rest and improved with exercise Effusions do not occur and muscle atrophy is absent Deformities do not develop The sedimentation rate and leukocyte counts are normal Radiographs reveal no significant articular change

Treatment —The treatment of rheumatoid arthritis is difficult arduous and most discouraging Local and systemic methods are employed requir ing the closest type of cooperation between practitioner and orthopedic consultant

Psychotherapy —A healthy mental attitude and a complete knowledge of the presenting problem are essential in order to obtain the necessary cooperation and understanding that must exist between patient and phys ician at the outset and throughout the course of the treatment of this perplexing disorder

The acute disturbance and its exacerbations are often associated with *emotional* and *situational difficulties* It is the function of the practitioner to seek these out and attempt to remove or allay the disturbing conditions

The patient and his family are to be instructed as to the chronicity of the affliction and its tendency to exacerbation It is cruel to make ex travagant promises for cure and then pass the patient down into the val ley of despair It is equally unfortunate if the picture is painted so darkly that all hope is abandoned Paraphrasing Winston Churchill in his advice to his countrymen in their hour of trial the patient should be prepared for sweat toil and tears but an eventual conquest of the enemy

Rest —In addition to peace of mind the patient must be prepared to take a long period of *bed rest* in the manner employed in the treatment of tuberculosis (p 267) The ambulatory forms of treatment of rheu matoid arthritis are unsatisfactory The protracted and progressive course of the disease makes it imperative that the best efforts be inaugurated early in the onset of the affliction so that there may be no repercussions later when disabilities become more evident and more marked

Home Physiotherapy —Bed rest encourages the complications of muscle atrophy flexion contractures and deformities unless a scheduled regimen of physiotherapy is laid down For the most part treatment can be carried out at home using the available facilities in order to prevent incurring additional expense

During the periods of rest and at night, the involved structures are comforted by the application of *heat* and *inunction* with Oil of Wintergreen The heat may be applied as hot wet packs the hot water bottle the electric pad an improvised baker or infra red irradiation

The tendency toward deformity is best counteracted by the use of a *removable splint* This also diminishes the pain in the acute phase A *bivalved plaster of-paris cast* (p 2092) affords the most relief It is worn continuously during the acute stage if symptoms are severe It is removed for examination and physiotherapy In the subacute and chronic stages the bivalved cast prevents development of contractures and for this purpose may be employed at night and part of the time during the day If it is not practicable to utilize the splint the involved joint is wrapped in a flannel or a woolen bandage or pinned up in a pillow

During the period of bed rest *hydrotherapy* is used to prevent atrophy and contractures The patient takes a *full tub bath* two or three times daily While immersed in the water *active and passive motions* are carried out and gentle *massage* is performed by some member of the family

Massage is of additional value while the patient is recumbent in bed It may be done while the part is heated by an infra red lamp If possible *massage is associated with active and passive motion* putting each joint through its normal range of motion If the patient can afford the services of a professional masseur this adjuvant is definitely to be recommended However if the expense is exorbitant probably as much can be accomplished by some careful and patient member of the family

Climatotherapy and Spa Therapy—Sooner or later the questions of climatotherapy and spa treatment arise The general principles outlined later (p 3761) apply emphatically to the patient with rheumatoid arthritis *Removal to a more equable climate will not cure the disease!* In point of fact it will not even prevent exacerbations or the development of deformity Nevertheless the patient whose finances permit removal to Arizona or New Mexico should be encouraged to try the method of transplantation Poor and indigent individuals to whom the expense of transportation would prove excessive and who would not have the means of support after their arrival in the desert should be urged to remain at home and utilize their limited funds for necessities

Spa literature often dangles reputed specifics as bait to the ignorant and unwary The patient is told of *healing waters mud packs sulfur baths natural springs radioactive pools* and *healing rays* The conscientious practitioner attempts to save his patient from this type of exploitation though there are times when common sense yields to the hope that springs eternal in the human breast

Dietotherapy—Dietotherapy has long occupied a place of prominence in the discussions of the treatment of rheumatoid arthritis Most observers believe that the patient should be given a *balanced high-calory diet* with the addition if necessary of *synthetic vitamins* Perhaps the most important single dietary factor is referable to stimulation of the palate Anorexia is a constant accompaniment of rheumatoid arthritis and the best results are obtained when the patient is given those foods *which he most enjoys* and is not asked to take foodstuffs that do not appeal to his appetite

The negative side of this question is summarized by stating that there

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Pregnancy and Jaundice—Pregnancy and jaundice seem to influence favorably the course of rheumatoid arthritis *The risk of pregnancy is to be evaluated before giving the patient any encouragement* The woman and her family should be warned that the improvement most likely will be transitory

The mechanism of the amelioration of symptoms by coincidental jaundice is of interest and *bile salts* (p 1990) may be administered in the hope of getting a similar effect *Unfortunately the artificial preparations seem less likely to be helpful* but they certainly do no harm

Nonspecific Protein Therapy—Nonspecific protein therapy is of value *for the majority of patients who suffer from rheumatoid arthritis* In the home or in office practice treatment is carried out by the use of *proteoses and peptones autogenous or stock vaccines* and intramuscular injections *of boiled milk* or *intravenous injections of typhoid vaccine* Sufficient dosage is employed to obtain a mild febrile reaction Improvement is usually manifest but unfortunately is most often transitory

Symptomatic Drug Treatment—A wide variety of pharmacologic agents are available for symptomatic drug therapy Because of the frequent presence of anacidity it is good practice to administer *hydrochloric acid* (p 1048) *before each meal* The *anemias* usually require the administration of a *hematinic* (p 1049) For this purpose a simple iron salt such as *ferrous sulfate* (p 1048) is ordered in preference to the more expensive and elaborate preparations There is no need to give liver extract or the antianemic gastric principle particularly since each of these costs considerably more than the iron On occasions *transfusions* of whole blood (p 3778) prove to be most tonic and certainly lift morale

Pain and joint effusions are controlled by *salicylates* (p 194) or the *coal tar products* (p 3833) That preparation which proves to be least disturbing to the appetite is to be preferred Some patients do best with a mixture of one part of *sodium salicylate* and two parts of *bicarbonate of soda* Others prefer the tablets of *acetylsalicylic acid* (p 3832)

During the period of bed rest and while the joint symptoms are severe *sedatives* and *hypnotics* are to be administered *Phenobarbital* in ¼ grain doses may be given after meals and a *sleeping potion* (p 3836) is administered at bedtime

Patients with a definite depression of the basal metabolic rate may be given tonic doses of *thyroid extract* (p 1189) Women who develop amenorrhea as so frequently happens or who are approaching the menopause may receive injections of *estrogen* (p 2515)

Specific Drug Therapy—Many drugs have been recommended for specific use in the treatment of rheumatoid arthritis but there is general agreement today that only the gold salts are worthy of considered attention

Before resorting to chrysotherapy which has definite treatment risk it is our practice to exhaust the other safer preparations Our first choice is a therapeutic test with *colchicine (p 2873) since the skeletal affliction may be an atypical form of gout* Preliminary reports of treatment with penicillin (p 106) and streptomycin (p 104) offer no encouragement for continuation of antibiotic therapy

After the trial of colchicine a course of *sulfonamide* (p 88) therapy is tried The drug has no consistently proved efficacy in rheumatoid ar

is *no special dietary principle of proved and consistent value* This statement covers low carbohydrate low protein alkaline ash vegetarian and all other faddist routines

Vitamin Therapy—There has been an enthusiastic promotion of the use of high concentrations of certain of the vitamins notably A B *and D* in addition to *crude egg yolk powder* Our experiences have not been sufficiently encouraging to warrant the expense that is necessary for the purchase of these substances unless the patient is well able to afford their cost without depriving himself of necessities In particular a highly potent vitamin D concentrate known as Ertron has been widely publicized Concerning its specific efficacy we are most dubious

Occupational Therapy—Occupational therapy is highly desirable particularly if invalidism is imminent Those patients who will be required to be self supporting must learn some skill by which they can later eke out a livelihood

Breathing Exercise—Fixation of the chest is a most impressive finding especially in the spondylitic varieties of rheumatoid arthritis In consequence we are insistent that patients carry out simple breathing exercises designed to increase the expansion of the chest raise the thorax and improve the hemodynamics of the internal viscera These breathing exercises are elsewhere described (p 3758)

Removal of Foci of Infection—The removal of possible foci of infection is suggested sooner or later with every patient who suffers from rheumatoid arthritis The practitioner should assume the position that he has no objection to the extraction of definitively diseased teeth or tonsils nor should he oppose intranasal surgery designed to eradicate a persistent nasal sinusitis The physician should be reluctant to advocate or favor promiscuous tooth extraction tonsillectomy intranasal gynecologic or urologic surgery the removal of the appendix or gallbladder the colon or the prostate when there is no local indication The patient with rheumatoid arthritis should no more be subjected to surgery of election than the normal individual *If a focus of infection is removed the patient must clearly understand that a cure of the rheumatoid arthritis is not to be anticipated* At best there will be temporary alleviation of symptoms Recurrences may be prevented but by and large the affliction will be altered very little in its natural course

Vaccines—If a focus of infection is removed it is proper to obtain a culture at the time of operation and prepare an *autogenous vaccine* from any pathogen that may be isolated We have no great enthusiasm for vaccine therapy but if this form of treatment is to be employed the patient is best inoculated with the demonstrably invasive organism *Stock vaccines* and *serums* are commercially available and widely used These include the Cecil typical arthrotropic strain of attenuated hemolytic streptococcus (Lederle) Clawson and Wetherby s strain of streptococcus vaccine (Lilly) Crowe s polyvalent streptococcus Rosenow s arthrotropic green producing streptococcus (Lilly) Small s antigen of the *Streptococcus cardio arthritidis* a gamma or indifferent streptococcus (Sharp and Dohme) and Wyatt Hick s arthrotropic streptococcus (Wyeth) The vaccine may be given *intracutaneously* or *subcutaneously* If the patient thinks the results are beneficial injections are continued

treatment deaths may approach 1 per cent The toxic reactions include *pruritus* which appears frequently and early in the course of therapy *erythematous and papular eruptions which are transitory and relatively* unimportant and *exfoliative dermatitis* which is a grave complication that *may terminate fatally In addition to the dermatoses gastro intestinal* manifestations may occur These include *sores in the mouth and on the tongue stomatitis nausea vomiting* and *diarrhea Jaundice* may occur on occasions and instances of *toxic hepatitis* have been reported *Blood dys crasias* including *aplastic anemia granulocytopenia* and *thrombocytopenia* arise and may result in death *Ophthalmic* and *neurologic complications* have also been reported

Our reactions to gold therapy are tentative and reserved It is our belief that the patient who is progressing unfavorably is entitled to know the possible benefits and probable dangers of chrysotherapy If discour aged by the course of his illness he decides that any risk is warranted rather than the ominous specter of chronic invalidism a course of therapy is definitely indicated The practitioner should protect the patient and himself by consultation with one experienced in the use of the drug though this is a potential rather than an actual boon since toxic reactions *are unpredictable and unavoidable The course of the treatment should* be followed by frequent blood counts including the enumeration of the platelets routine urine analyses and a careful survey of the entire phys ical status before each fresh injection is administered

Those who enthusiastically advocate chrysotherapy believe that the best results are obtained if patients are treated *early in the disease* This opinion is fortified by results obtained in experimental animals In reach ing his own decision in the matter the practitioner must weigh the reputed 50 per cent improvement using large doses of gold against the 17 to 40 per cent incidence of toxic reactions *Before* any commitment is made the practitioner owes it to himself to discuss the problem with his patient Only in this way will he avoid later recriminations when the progress of the disease proves to be so unsatisfactory In point of fact a great deal depends upon the patient s attitude toward the disease Many individuals would rather be dead than incapacitated and they will choose the heroic forms of therapy Others more timid in their reactions prefer safety to risk particularly in view of the 75 per cent favorable course in the natural evolution of the disease

Special Forms of Physiotherapy—As the course of the rheumatoid ar thritis progresses it is inevitable that the patient should seek more for midable measures of physiotherapy Exposure to *ultraviolet light* (p 3794) if it does nothing else produces a tanning of the body and improves morale Many physiotherapists believe that *diathermy* (p 3788) exercises a specific effect by the production of penetrating heat Sooner or later the patient will wish to try this therapeutic suggestion and if the expense is warranted by the improvement therapy should be continued

Many of the *roentgen therapists* advocate irradiation particularly of the spine The senior author entertains no enthusiasm concerning the efficacy of the procedure but his associate believes that the method is worthy of trial in early spondylitis

Hyperpyrexia (p 3789) despite the splendid results that are obtained

thritis but a test period of a week to ten days is warranted A more continued administration holds promise only of toxicity There is no harm in trying a course of *iodides* but the drug should be stopped after seven to ten days unless spectacular improvement has occurred Protracted administration produces both dermatologic and gastro intestinal disturbances As to *cinchophen* (p 3833) and its associated preparations such as *Tolysin* or *Atophan* we hold to a position of unalterable opposition These preparations are *without specific value and we have had the misfortune of* observing two fatalities due to *toxic hepatitis*

The only drug preparation that offers any tangible evidence for specific effect in rheumatoid arthritis is gold Concerning this we admit we have little enthusiasm and great fear In the United States the preparations of widest choice are the salts of *gold sodium thiosulfate* which may be given intramuscularly or intravenously The following list includes the more commonly used preparations with their trade and chemical names

Name	Content of Gold (per cent)
Allochrysin —Auro thiosulfonate of sodium	35
Crisalbine —Gold sodium thiosulfate	*37*
Sanocrysin —Double thiosulfate of gold and sodium	37
Lopion —Auro thio urea benzoate of sodium	40
Triphal —Sodium auro thiobenzimidazocarboxylic acid	44
Solganol B —Auro thioglucose	*50*
Myochrysine —Auro thiomalate of sodium	50
Aurol sulfide —Au S_2 colloidal gold sulfide	97

Chrysotherapy with gold sodium thiosulfate is initiated by the *intravenous injection* of 5 mg Weekly injections are made if possible using increasing dosage until a maximal dose of 100 mg can be introduced An attempt is made to give a treatment course with a total of 1 to 2 gm and a suggested series schedule calls for fourteen injections beginning with 5 mg and increasing successively to 10 15 35 50 and 75 mg On the seventh injection 100 mg is given and this amount is continued for the rest of the series It is generally agreed that the patient should have at least two courses of treatment with an interval of at least two months between the first and second courses If no improvement is shown at the end of three courses *treatment should be discontinued* If patient and physician agree that therapy has been worthwhile as many as four complete series may be concluded provided there are no untoward reactions

The *beneficial results* of gold therapy even in the most *favorable instances* are not noted for at least three months and relapses are admitted in as many as 15 per cent of the patients treated The protracted period of treatment and the known spontaneous remission of the disease make it quite impossible for the practitioner who deals with isolated cases under less than *ideal conditions* to evaluate his own experiences

Much more definite is the *toxicology* of gold treatments It is generally agreed that untoward effects are seen in 50 per cent of those treated and

of the American Medical Association and that decision is reenforced by our experiences

The list of useless remedies at the present time is completed by the vasodilators *histamine choline* and similar substances As might be expected from a knowledge of the transitory and ephemeral efficacy of these products the treatment results are disappointing except in the hands of the enthusiasts who add *suggestion* to pharmacotherapy

Vis Mediatrix Naturae—Despite this critical and disappointing review of the available therapeutic measures the outlook in rheumatoid arthriti is not wholly black In point of fact *the disease is arrested more or less permanently at one stage or another in approximately 75 per cent of all cases* The residual disability may be relatively minor or only sufficient to have nuisance value so that an ordinary life with limitation may be led with relative comfort It is the frequency of these spontaneous arrests that accounts for the number of the alleged cures and the difficulty of evaluating any specific therapeutic procedure Thus for example in chryso therapy it is claimed that good results are obtained in approximately 50 per cent of the cases If two or three courses of the drug are given with intermissions of two or three months the span of time that is occupied in the cure stretches out to eighteen or twenty four months The practi tioner who recalls the time factor in known specific chemotherapy such as that which is noted with sulfonamides and the arsenicals looks with sus picion upon specific results that take so great a length of time to accom plish their purpose in a disease that is known to be punctuated by spon taneous remissions

In all likelihood whatever modality happens to be used at the time the patient goes into his remisison is the one accounted as a successful thera peutic agency That cure is then recommended to all fellow sufferers The variability of the results in all likelihood is not dependent upon a different behavior of the disease in different individuals but is merely a matter of timing

The patient may be told in all frankness that rheumatoid arthritis leads to *disability* and at most *invalidism* This i in striking contrast to rheumatic fever which carries a *mortality* due to cardiac complications Many of our mo t important and useful citizens have been afflicted with rheumatoid arthritis but have managed to make their contributions de spite the skeletal disturbance

S   *y of Adio t d F ms f T e tment*

Bed est
Loc l appl cat of heat
I nmob l at on of affi ted joint
Hot bath w tl a t an l pass e mot on an l mass e
B atl ng e er es
W ll l n l l gl-cal y l gh itam n let to ta te
O cupat onal tl r py
Hydrocl lo acid bef l
Fer o s sulfate fte meals
Sodium sali ylate between r e l d at bedt me
Phenoba b tal ¼ gra n aft meals
Hypnot c at bedt me
Saline purge two o tl ee times we kly

in the gonorrheal types of arthritis holds no promise of significant improvement for the patient with rheumatoid arthritis In addition the rigors of therapy are such as to add to the depletion and enervation of the afflicted

During the active stages of a rheumatoid arthritis splints braces and corrective exercises may prevent deformity and avert the necessity for later corrective surgery

Orthopedic Surgery—When the active phases of rheumatoid arthritis have been completely terminated the practitioner is justified in consulting his orthopedic specialist in order to ascertain whether corrective operative procedures are advisable and justifiable Before instituting any surgical measure however it must be established that the disease is inactive as manifest by an absence of clinical symptoms for a period of at least eighteen months and a normal temperature curve and sedimentation rate

The operative technics which may serve to improve the status of the patient include *arthroplasty* in order to restore some measure of joint function *arthrodeses* to fuse firmly a joint whose motion is of no value but which is productive of pain, *tenotomies* to relieve contractures *capsulotomies* for correcting obstinate flexion deformities of the knees *osteotomies* for the removal of bony prominences and spurs and *synovectomy* where there are hyperplastic changes in the region of the knee

General Surgery—It was inevitable that the general surgeon should attempt to enter the arena of therapy in rheumatoid arthritis The splenomegaly of Still s disease led to the suggestion of *splenectomy* *Thyroidectomy* and *parathyroidectomy* have also been performed without any help to the patient *Sympathectomy* was suggested as a means of obtaining vasodilatation to the afflicted joints *Colectomy* was advocated by those who ride the hobby horse of intestinal poisoning *Appendectomy cholecystectomy prostatectomy* and complete *hysterectomy* have each and all been performed in various cases and there is sufficient evidence now to report that none of these influences the course of a rheumatoid arthritis

Correction of Intestinal Toxemia—Many physicians are quite convinced that intestinal auto intoxication is an important factor in the symptomatology of rheumatoid arthritis In consequence various types of *therapy have been recommended These include daily saline purges weekly calomel courses colon irrigations implantations of Bacillus coli* by rectum and implantations of the *Bacillus acidophilus* through the ingestion of seeded milk and the administration of beta lactose None of these procedures is productive of harm and each may be tried

Useless Measures—No presentation of the treatment of rheumatoid arthritis would be complete without an enumeration of the useless and dangerous measures These include penicillin *sulfur* by mouth or by injection injections of *cobra venom bee stings* and the use of *bee venom manipulative treatment* and the uses of *formic acid chaulmoogra oil* the *arsenicals* and the *benzoates* We are particularly opposed to manipulative treatment despite the excellence of this therapy in fibromyositis In rheumatoid arthritis manipulation is a distinct hazard and may add traumatic disturbances to the already heavy burden of deformity and disability The wide publicity given to the benzoates requires a special note that these have not been accepted by the Council on Pharmacy

LEGG CALVE PERTHES DISEASE

Legg Perthes disease is seen in children between the ages of four and nine years It is more common in boys than girls There is a generalized *aseptic necrosis* (p 2801) of the *capital epiphysis* which is softened and subject to distortion if weight bearing is allowed The process is self limited in several years and the dead epiphysis becomes revascularized and replaced by living bone of normal density

The clinical manifestations are heralded by a *limp* with *pain* that is referred to the hip joint and varying degrees of *limitation of motion* There may be actual *flexion contractures* of the joint itself *Radiographs* reveal that the capital epiphysis appears unusually dense in contrast to

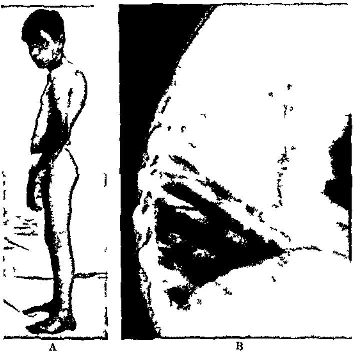


Fig 56 —*A* Adolescent kyphosis associated with vertebral epiphysitis *B* Roentgenogram

the faintness of the adjacent atrophic bone If weight bearing has been permitted the articular head collapses leading to an appearance which may be mistaken for a tuberculosis However the joint spaces remain intact and the confirmatory signs of infection are lacking

Treatment requires the avoidance of weight bearing during the period in which the head is being reconstituted The patient is put to bed or immobilized in plaster If treatment is started early and continued faithfully the results are excellent However if the head becomes deformed by weight bearing the patient may anticipate the development of a severe osteo arthritis of the hip beginning in adult life This results in restriction of motion pain and disability for the remainder of life

Caldwell, in Pullen, Medical Diagnosis

Calomel purge once each fortnight
Bile salts before meals

Specific Drug Therapy to be Successively Tried at the Beginning of Treatment
Colchicine
Sulfonamide
Iodide

Relatively Harmless Measures to Be Tried if Above Therapy Is Not Successful
Administration of thyroid extract
Administration of synthetic vitamins
Injection of estrogen
Nonspecific protein therapy with boiled milk or intravenous typhoid vaccine
Formal physiotherapy (ultraviolet irradiation diathermy professional massage corrective exercises)
Stock vaccines Antibiotic therapy with penicillin and streptomycin
Bacterial implantations (B coli B acidophilus)

More Formidable Measures Next to Be Considered
Repeated transfusions
Eradication of focal infection in teeth tonsils and nasal accessory sinuses
Eradication of focal infection in female pelvic organs and prostate
Deep roentgen therapy
Chrysotherapy
Injection of autogenous vaccine
Climatotherapy and spa therapy

Dangerous Methods to Be Avoided
Manipulation
Administration of cinchophen
General surgical procedures such as splenectomy thyroidectomy parathyroidectomy sympathectomy colectomy
Hyperpyrexia

EPIPHYSITIS (OSTEOCHONDRITIS OSTEOCHONDROSIS)

Epiphysitis is a self limited affection of an epiphysis which probably occurs on the basis of a *localized ischemia* or disturbance in blood supply with a resultant *aseptic necrosis* (p 2801) The condition has been described in various sites as different diseases Thus the adolescent round back or vertebral osteochondritis is known as Scheuermann s disease in the hip it is called Legg Calve Perthes disease in the knee Osgood Schlatter s disease in the heads of the metatarsal bones Freiberg s disease in the tarsal scaphoid Kohler s disease and in the carpal semilunar bones Kienbock s disease

VERTEBRAL OSTEOCHONDRITIS (ADOLESCENT ROUND BACK ADOLESCENT KYPHOSIS SCHEUERMANN S DISEASE)

In early childhood a localized epiphysitis may occur in isolated *vertebral bodies* This results in the formation of wedge shaped vertebrae which produce a *minor kyphosis* (vertebral osteochondritis)

In the adolescent the epiphyseal ring which forms the lip of the vertebral body adjacent to the disk may be the site of similar changes These cause a more diffuse type of *adolescent round back* since several or nearly all of these rings are simultaneously involved

The *treatment* requires that the back be put at rest and an effort made to correct the deformity It may be necessary to use a brace or a plaster jacket for support and institute corrective exercises at a later date.

OSGOOD SCHLATTER S DISEASE

Osgood Schlatter s disease is an aseptic necrosis (p 2801) of the epiphysis of the *upper end of the tibia* It occurs where the bone expands to form the tibial tubercle at the insertion of the patellar tendon It is most frequently seen in boys at the age of twelve years There is a complaint of tenderness and pain and slight swelling is noted at the insertion of the patellar ligament Motions which put the structure under strain produce considerable discomfort Radiograph shows an increase in density and fragmentation of the tibial tubercle

Since the tibial tubercle does not bear the superincumbent weight the patient need not be put to bed It is necessary however to limit the action of the quadriceps and this is accomplished by *immobilizing the*

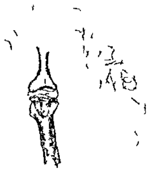


Fig 9—Osteochondritis of second metatarsal head or Freiberg s disease (Drawing from roentgenogram)

knee in extension If adhesive strapping fails to accomplish the purpose a long leg plaster of paris cylinder (p 2992) is applied

FREIBERG S KOHLER S AND KIENBOCK S DISEASE

Aseptic necrosis may also occur at the heads of the *metatarsal bones* (Freiberg s disease) at the *tarsal scaphoid* (Kohler s disease) and in the *carpal semilunar bone* (Kienbock s disease) The last disease may occur in adult life while the other afflictions are noted in childhood

Treatment requires *immobilization* until reconstitution of the bone has been accomplished Various operative procedures are required if there is pain particularly *metatarsalgia* (p 3086) These procedures are so intricate and require such discriminating judgment that the patient should be referred to the most competent specialist before making any positive moves

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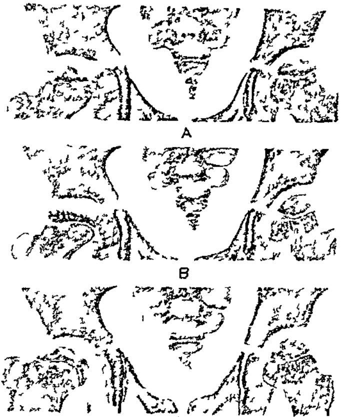


Fig ~57—Coxa plana A Early stage Note beginning flattening of the femoral epiphysis B Advanced stage Note fragmentation of epiphysis C Healed stage Note flattening and broadening of head and neck (Drawing from roentgenograms)*

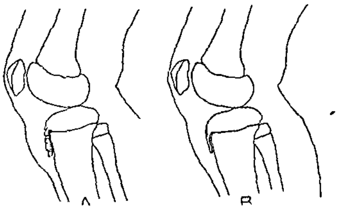


Fig ~8—Osteochondritis of the tibial tuberosity (Osgood Schlatter's disease) A Affected knee B normal knee (Drawing from roentgenogram)*

Sl n ls, H u dbook of Orthopaedic Surgery C V Mosby Comp ny

within the canal results in a compression of the capillaries and ischemia of the areas supplied by these vessels The infection rapidly progresses through the impoverished tissues and the inflammatory process bursts



Fig. 60 —Acute osteomyelitis of the proximal end of the humerus slight rarefaction at base of trochanter Duration one week

through the epiphyseal plate into the medullary cavity and the subperiosteal region of the periphery of the cortex From these areas the infec

Key in Lewis Practice of Surgery W F Prior Co Inc.

ACUTE PYOGENIC OSTEOMYELITIS

Acute pyogenic osteomyelitis is most often caused by *Staphylococcus aureus* but the *Staphylococcus albus* streptococci pneumococci gonococci meningococci and the bacilli of the typhoidal fevers and brucellosis may also cause similar manifestations

Pathogenesis—Pyogenic osteomyelitis most often follows a *skin infection* such as a staphylococcal pyoderm (p 3248) The skin lesion may be well healed by the time the bony focus becomes manifest and its relationship to the osseous infection is only revealed by the history

DIFFERENTIAL DIAGNOSIS OF

Disturbances of the Epiphyses

Epiphyseal disturbances carry a serious threat since they interfere with skeletal growth In the event of involvement, the practitioner must conduct a complete examination and ref r his patient to the orthopedic pecialist for consultation

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Premature Closure	
Achondroplasia	Producing dwarfism (p 2762)
Delayed Closure	
Anterior Pituitary Hypersecretion	Resulting in giantism (p 1155) Refer to neurosurgeon
Neonatal Syphilis	Positive serology Therapeutic response to pen cillin (p 2787)
Rickets	Therapeutic response to vitamin D and calcium (p 2850)
Scurvy	Bleeding tendency Therapeutic response to cevitamic acid (p 1120)
Abnormalities	
Aseptic Necrosis	Of vertebrae in Scheuermann s disease (p 2926) Of hips in Legg Calvé Perthes disease (p 2927) Of knee in Osgood Schlatter s disease (p 2929) Of foot, in Freiberg Kohler s disease (p 2929) Of wrist in Kienbock s disease (p 2929) Fractures
Trauma	With subluxation or fracture of head of femur humerus radius or carpus

The invading organism localizes in the metaphysis the area of the shaft of the long bone that is adjacent to the epiphyseal cartilage Here the capillaries make sharp hairpin bends just before reaching the epiphyseal plate This conformation is thought to be the explanation for the frequency of localization in this site since the capillary stream is significantly slowed Pyogenic osteomyelitis is primarily a disease of *younger people* in whom the epiphyseal plate has not yet disappeared Often *trauma* plays a predisposing role by lowering the local resistance to infection and there is often a history of preceding injury to the involved area

Because of the rigid envelope of bone, the swelling that takes place

long bones adjacent to a joint There are usually associated constitutional symptoms which at times overshadow the local manifestations The attention of the patient and his physician may be focused on the *chill* and *hyperpyrexia* while the skeletal symptoms are minimized or overshadowed by the prostration due to the fever Sooner or later attention is drawn to



I g 6 —Extens e d struct n and format on of w bo e Roent enograms made in ame case as that r p sei t d n I g 60 but n ne months lat

the local pain and tenderness Gentle manipulations reveal that the maximum tenderness is over the bone adjacent to the joint rather than involving the articular structure itself

In the early stages localized *swelling* is not particularly marked Sooner

tion spreads rapidly toward the center of the shaft the epiphyseal plate acting as a barrier to prevent involvement of the adjacent joint This device however is not universally successful and about one fifth of the patients with acute pyogenic osteomyelitis suffer also from a complicating *suppurative arthritis*

In the era before the advent of the sulfonamides the spreading infection soon created an *abscess* involving the entire shaft of the bone in its enclosed periosteum Dead bone was bathed in a pool of pus Occasionally a subperiosteal abscess would perforate spontaneously into the soft tis

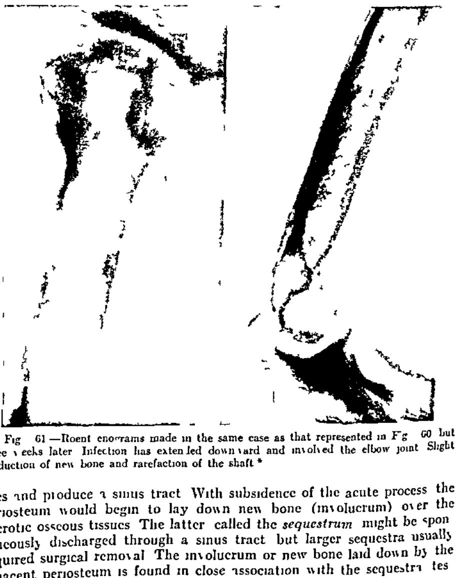


Fig 61 —Roentgenograms made in the same case as that represented in Fig 60 but three weeks later Infection has extended downward and involved the elbow joint Slight production of new bone and rarefaction of the shaft *

sues and produce a sinus tract With subsidence of the acute process the periosteum would begin to lay down new bone (involucrum) over the necrotic osseous tissues The latter called the *sequestrum* might be spontaneously discharged through a sinus tract but larger sequestra usually required surgical removal The involucrum or new bone laid down by the adjacent periosteum is found in close association with the sequestra testifying to the simultaneous occurrences of destruction and repair

Clinical Manifestations —Acute pyogenic osteomyelitis is usually ushered in by the sudden onset of *severe pain* localized at the end of one of the

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Systemic Mycoses	Destructive arthritis and/or osteomyelitis may be acute subacute or chronic Lumpy jaw in actinomycosis (p 489) Desert rheumatism in coccidioidomycosis (p 499) Lesions also in histoplasmo is (p 504) Identify organisms in joint fluid or biopsy Skin test for coccidioidomycosis
Syphilis	Polyarthritis in secondary stage with positive serology (p 337) Charcot joint with painless destruction in tabetics with po itive spinal fluid (p 1466)
Trichinosis	Nematode infestation with myalgia eosinophilia and swellings under eyes Skin test and complement fixation (p 539)
Tuberculosis	Arthritis or osteomyelitis with extensive destruction of bone and minor inflammatory evidences (cold abscess) May break through and dissect producing Pott s abscess of soft tissues X ray for evidences of pulmonary or renal lesion and to determine extent of local lesion Do skin test and sedimentation rate (p 252)
Typhoid Fever	Osteomyelitis with bone abscess May occur long after subsidence of acute infection Culture bacillus from pus (p 54)
Virus Infections	Generalized myalgia arthralgia and/or ostalgia but no locali ing signs in common cold influenza dengue mea les smallpox choriomeningitis psittacosis sandfly fever and yellow fever (p 387)

or later it appears and when the subperiosteal abscess forms it becomes all too obvious The abscess may rupture into the joint giving the appearance of a suppurative arthritis or it may break through the skin to form a sinus tract

Occasionally pyogenic osteomyelitis involves the deeper bones of the *vertebrae* and the *pelvis* Under these circumstances the objective manifestations are not obtained and the presenting symptoms are reduced to *localized pain* and *tenderness* When the attention of the examiner is focused on the area marked spasm of the adjacent musculature and *limitation of mobility* may be noted If the condition is not recognized and promptly treated a *paravertebral abscess* may develop and be recognized as a *psoas abscess pointing beneath Poupart s ligament or in the region* overlying the paravertebral musculature

Laboratory Findings—The laboratory findings are those of an acute systemic infection The blood count reveals a marked *leukocytosis* the *sedimentation rate* is increased and *blood cultures* are nearly always positive *in the early stages The x-ray which is normal for the first week or ten* days later reveals a ragged moth eaten appearance at the time when the sequestra and the involucra form *Aspiration* of soft tissue swellings may yield *pus* in which the invading organism is recognized through smears and cultures

Course.—*In the period before the introduction of the* sulfonamides the

DIFFERENTIAL DIAGNOSIS OF

The Commoner Febrile Skeletal Disorders

In the minds of the laity all inflammatory disturbances that involve bones joints muscle bursae or subcutaneous fibrous tissues are lumped together as rheumatism The following table gives only the commoner skeletal d sturbances associated with fever Non febrile afflictions are listed later in the section devoted to Di turbances of the Skeletal and Loco motor System (p 2795)

CAUSE	DIAGNOSTIC FEATURES
Atrophic Arthritis	Idiopathic progressive polyarthritis of young adults Vasomotor instability Tendency to muscle atrophy with ankylosis (p 2910) All tests negative except sedimentation rate
Blood Dyscrasias	Fever with hemarthrosis or periostitis re spectively in hemophilia (p 1118) or scurvy (p 1120) Note capillary fragility in latter and response to vitamin C
Bone Neoplasms	Fever especially with Ewing and osteogenic sarcomas (p 2845) X rays and biopsy positive
Brucellosis	Arthritis and osteomyelitis may be acute ub acute or chronic Skin test Culture joint aspirate (p 314)
Dermatomyositis	Rare disease with skin and muscle lesions Get blood culture and biopsy Look for evi dences of carditis (p 3373)
Gonococcemia	Pyarthrosis with or after urethritis Look for focus in prostate vesicles or uterine adrexa Get blood culture and complement fixation (p 219)
Gout	Polyarthritis sometimes with great toe involve ment (podagra) in older males Look for tophi in ears Blood uric acid in excess of 5 mg Specific response to colchicine (p 2874)
Poliomyelitis	Epidemic virus disease with paralyses follow ing prodromal febrile period Get spinal fluid (p 3736) and examine blood for virus neutral izing bodies
Pyogenic Infection	Of joints and/or bones Obtain pus for smears and cultures in pyarthrosis Take x rays Make blood cultures in suspected bacteremia (strep tococcus staphylococcus gonococcus menin gococcus)
Rheumatic Fever	Polyarthritis or growing pains usually in children or young adults Seek evidence of carditis Note rapid sedimentation rate and specific response to salicylate (p 185)
Rickettsial Infections	Generalized myalgia but no localizing symp toms
Scarlet Fever	Arthralgia and occasional pyarthrosis in se vere infections Note rash or desquamation (p 171)
Serum Sickness	Polyarthritis usually at time of urticaria (p 85)
Spirochetosis	Arthralgia or serous effusion in infectious jaundice and rat bite fe [illegible]

bones and joints These are most often of *syphilitic* or *tuberculous* origin The characteristic lesion of *actinomycosis* (p 489) is often a chronic osteo myelitic process involving the jaw (lumpy jaw)

SYPHILITIC PERIOSTITIS

Syphilitic periostitis is seen most often in *children* It is characterized by a localized or diffuse thickening of the affected area There may be a



Fi "G —Ro ntgenograms mad in the same case as that repr sented in Fi "G The elbow ankylosed but the i fection in the bone s st ll acti e The roentg nogram on the left was made one month and the one on the right as made two and a half yea s after the onset of the disease

reasonably large depo it on the bone with accompanying deformity as seen most characteristically in the *saber shin* of *prenatal syphilis*

X rays reveal increased bone formation and a narrowing of the medulla The *diagnosis* is sugge ted by the associated evidences of *prenatal syphilis* (p 2787) and the positive *serologic data* (p 337)

In the later stages of syphilis a *gummatous periostitis* and osteitis are sometimes observed There is a resultant necrosis of bone with pathologic

management of acute and chronic *pyogenic osteomyelitis* was most discouraging In the early phases the patient was extremely ill and there was an appreciable mortality During the chronic phases of the disease sinus tracts formed and drained intermittently for years and decades *Amyloid disease* (p 7) was a frequent accompaniment of the prolonged suppuration *Metastatic involvement* of other bones constituted a constant threat Permanent cure was rare and it was generally agreed that once an osteomyelitis always an osteomyelitis

Diagnosis—The diagnosis of acute osteomyelitis requires differentiation of the *acute infectious arthritides* and *bone tumors* particularly of the malignant variety An *arthropathy* can be distinguished by physical examination With gentle *manipulation* joint motion can be demonstrated and the point of tenderness localized to the juxta articular bone or the shaft Malignant bone tumors such as the *osteogenic sarcoma* (p 2845) and the *endothelial myeloma* (p 2845) also occur most often in the young age group and are localized in the shaft and associated with severe pain fever and leukocytosis Even the expert may misinterpret the findings and the x rays so that the correct diagnosis awaits histologic section taken by biopsy or at operation The presence of bacteremia and a response to sulfonamide therapy worthy of a trial in any instance favor the presence of an infectious rather than neoplastic process

Treatment—The treatment of acute pyogenic osteomyelitis has been revolutionized by the introduction of sulfonamides and penicillin (p 106) Immediately upon making the diagnosis and even before the nature of the infecting organism has been confirmed by cultures *sulfadiazine* is administered orally or parenterally and penicillin is injected intramuscularly With prompt and intensive therapy the process is arrested in a large proportion of cases before there has been sufficient bone destruction to produce a large sequestrum With persistent manifestations streptomycin (p 104) may be added or substituted in the program of therapy

The *surgical management* of acute osteomyelitis is much disputed The radical surgeons believe that immediate operation should be performed as soon as shock has been controlled and the general condition warrants the technical procedure The operation consists in making an incision down to the bone and decompressing the inflammatory area by multiple drill holes The more conservative orthopedic surgeons defer operation and then intercede only for the purpose of draining a subperiosteal abscess The bone is not disturbed until the sequestra have been well demarcated for at least several months Our tendency is toward the latter or conservative form of management Meantime the affected structure is rigidly immobilized in a bivalved plaster cast

CHRONIC OSTEOMYELITIS

Chronic osteomyelitis is most often a sequel of the acute infection It is characterized by the formation of the *involucrum* and the frequent discharge of *sequestra* The latter are usually preceded by redness and swelling of the overlying skin or by edema of the pre existent sinus tract Chronic osteomyelitis may respond beyond expectation to massive doses of penicillin given intramuscularly and instilled into the sinus tracts

Chronic osteomyelitis accompanies other chronic inflammations of the

SYPHILITIC ARTHRITIS

During the *secondary stage of syphilis* an *arthralgia* unaccompanied by objective signs of inflammation is frequently noted This disappears with specific therapy and leaves no deformity

Prenatal syphilis (p 2787) occasionally manifests itself by a symmetrical *serous synovitis* (*Clutton's joints*) This is a painless effusion which is noted at the age of puberty and disappears when growth is complete In neglected syphilis *gummatous changes* due to infiltration of the synovial structures have been reported but are rarities in present day medicine

The most frequently encountered syphilitic arthropathy is the *Charcot joint* which is not due to local involvement by the luetic inflammation but



Fig 765



Fig 766

Fig 765—Syphilitic osteochondritis and periostitis in an infant two months of age (Kampmeier Essentials of Syphilology J B Lippincott Co)

Fig 766—Osteomyelitis of distal end of humerus osteochondritis and periostitis of all bones

is secondary to the changes that occur in the central nervous system under which healing the condition is described (p 1468)

TUBERCULOUS OSTEO ARTHRITIS

Before the widespread adoption of pasteurization of milk tuberculous arthritis was an extremely common condition In the present day it is quite rare and is most often seen in *childhood* with slightly greater frequency in *males*

fracture When the bridge of the nose is involved there may arise the characteristic saddle nose"

SYPHILITIC OSTEOCHONDRITIS

Syphilitic osteochondritis is almost invariably present in prenatal syphilis It appears in the fifth month of fetal life and, in the most clear examples all of the epiphyses are involved The most actively growing sites in the long bones manifest the process to the greatest degree



Fig 764—Periostitis of syphilitic origin involving most of tibial shaft.

In clinically recognizable syphilitic osteochondritis the patient complains of *pain* and *swelling* over the ends of the affected long bones *Tenderness* and *muscle spasm* are noted in association with the subjective complaint X *rays* reveal raggedness widening and irregularity of the epiphyseal lines There may be associated syphilitic periostitis *Epiphyseal separations* occur The diagnosis rests on the osseous lesion found in conjunction with other evidences of prenatal syphilis in an infant with positive serologic findings or in one whose mother has such positive findings

Treatment is directed to the control of the underlying infection No local therapy is required since the cartilaginous and osseous deformities yield phenomenally well to anti syphilitic drugs (p 340)

* Caldwell, in Pullen, Medical Diagnosis

Hyperparathyroidism	Hypercalcemia and hypopho phatemia Usually due to benign tumors of parathyroid glands X rays reveal cyst formation osteoporo is and pathologic fracture (p 1225) Look for evidences of renal calculus Consider exci ion of glands
Osteitis De ormans	Paget s disease with thickening of cortex and bowing of legs High blood alkaline phosphatase and enlargement of cranium (p 2879)
Infection and Inflammation	
Rheumatoid Arthritis	Spondylitis of Marie Strumpell type Inflammatory disturbance in ptotic adolescents and young adults Involvements of any and all joints especially pine and proximal inter phalangeal Note pyrexia increased sedi *mentation rate muscle atrophy and vaso*motor instability (p 2910) Institute complete *therapeutic routine*
Tuberculous Osteo-arthritis of Spine	Chronic infection of vertebral bodies Note kyphosis formation of cold abscess limitation of motion muscle spasm and later evidences of spinal cord compression (p 2942) Get x rays and refer to orthopedic specialist
Infectious Osteo arthr tis of Spine	Usually hematogenous with bacteremia Involvement of metaphysis with abscess formation Institute anti infective therapy (p 2910) Consider surgical exploration
Fibromyositis	Non suppurative inflammation of connective tissues Localized pain tenderness limitation of motion nodule formation and induration (p 2894) Note therapeutic re ponse to local procaine injection
Neoplasm	
Osteo d O teoma	Benign tumor X ray reveals central area of diminished density and surrounding zone of bone sclerosis (p 2840) Refer to orthopedist for recommendations as to therapy
Metastatic Carcinomatosis	Osteolytic or osteoplastic lesions econdary to primary growth identi ied el ewhere (p 2848) Consider x ray therapy
Multiple Myeloma	Bence Jones proteo e in urine Marrow cells identified in biopsy from sternal puncture (p 1126)

Pathology—Tube cul s s of the joints s a *he at gen nfecti n* which arises from a primary focus in the p b oncl al or abdominal lymph nod A la ge proportion of the ffl ct ons are due to the *bov ne types* of the tub cle b cillus

The e is often a history of *t auma* to the ffected area Th s may predispose to the localizat on wh h u ually starts in that portion of the bone directly adjacent to the joint and later olves the articul t on I oth r nstances the tubercle may localize directly in the synov al membrane but h n the jo nt is involved *tuberculous granulat on t ssue* spreads o er the synovia and invades the articular cartilage There is an *effusion* of tuberculous pus and the bone adjacent to the tuberculous g anulation tissue becomes invol ed The bony trabeculae are gradually destroyed and replaced by the debris and granulat on tissue due to the nfection Tuber les may be visible on the synovi l m mb n The end result is destruct on a d at ophy of th bo e end and articular cart lag s

Clinical Manifestations—In addition to the constitutional symptoms common to all tuberculous infections (p 252) the afflicted child develops

DIFFERENTIAL DIAGNOSIS OF

Thoracic and Upper Lumbar Pain

In the majority of instances the problems of back pain have to do w th lower lumbar sacro iliac and coccygeal regions (p 2970) Less often the patient complains of discomfort in the cervical region (p 2968) or the thoracic and upper lumbar spines Under any circumstance the elucidation of the cause requires expertly contrived x ray examinations including antero-posterior lateral and lateral oblique views in recumbent and weight bearing positions

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Cervical Rib	Pressure on neighboring structures may cause neuritic pain along ulnar side of arm and forearm Pareses and wasting of hand muscles Pulse may be obliterated Refer to orthopedist for surgical intervention (p 2953)
Congenital Elevation of Scapula	Sprengel s deformity with local pain relieved by division of band (p 2823)
Traumatic or Mechanical	
Subluxations and Dislocations of Vertebrae	Seen on lateral oblique and lateral views Refer to orthopedist for reduction (p 2966)
Fractures of Vertebrae	Immobilize patient in hyperextension until orthopedic surgeon can be summoned (p 3005)
Acute and Chronic Postural Strain	Usually involving upper cervical and shoulder regions In office workers who sit up or bend over while at their duties
Psychogenic	Hysterical contractures (p 1367)
Neurogenic	Transverse myelitis multiple neuritis and tumors of cord Note sensory motor and reflex changes Get cerebrospinal fluid and refer to neurosurgeon
Visceral	Referred pain in thoracic region With lobar pneumonia empyema pleurisy coronary insufficiency and occlusion and angina pectoris Get chest x rays and Ecg In lumbar region with perinephric abscess nephrolithiasis carbuncle of the kidney pyonephrosis and hydronephrosis Examine urine Get scout film and urogram (p 2252)
Metabolic Disturbances	
Osteo arthrosis of Spine	As part of generalized osteo-arthrosis Metabolic disturbance usually in obese middle aged patients with hypometabolism Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine
Osteoporosis of Spine	Diffuse decalcification Narrowing of vertebral bodies and widening of intervertebral disks Usually in senile (p 2517) Produces kyphosis without supportive therapy

CONTINUED

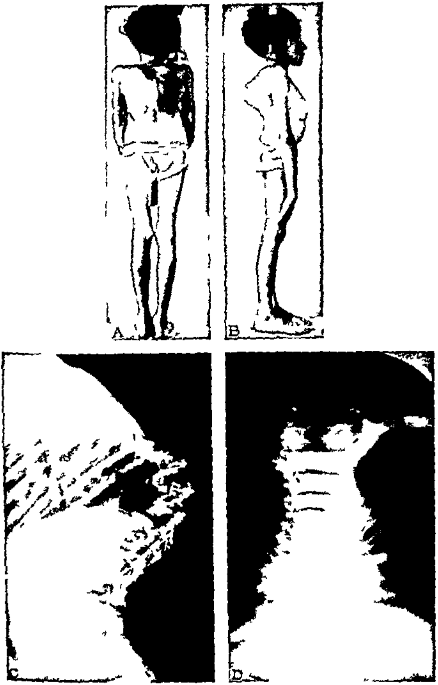


Fig 67.—A and B Advanced tuberculosis of dorsal spine *C* Lateral view advanced tuberculosis of dorsal spine *D* Anteroposterior view tuberculosis of the spine

Caldwell, in Pullen, Medical Diagnosis.

localizing symptoms referable to the involved joint The complaints include *limitation and pain on motion spasm local heat* and *swelling joint effusion* and *muscle atrophy* In the later stages *joint deformity* and *contractures* are encountered A frequent presenting symptom is the *night cry* which results from sudden movement during sleep when the muscles about the joint are relaxed

Tuberculosis of the Spine—Pott's disease is a tuberculous involvement of the body of the vertebrae The posterior arches and their processes are very rarely involved but the inflammatory process invades the cancellous portions of the bodies usually involving several adjacent vertebrae

The bony structure is replaced by *tuberculous caseation tissue* and the intervertebral disks are destroyed early in the process Sooner or later a large *paravertebral abscess* is formed The involved vertebral bodies collapse resulting in a *kyphosis of the spine* The paravertebral abscess dissects along the psoas sheath if it is originally in the lumbar spine or along the ribs if the dorsal areas are involved Healing may occur after several years through bony fusion of the involved vertebrae

CLINICAL MANIFESTATIONS—The earliest symptoms of spinal Pott s disease are *limitation of motion* and *pain* in the involved area Often the discomfort is worse at night and the night cry is characteristic Limitation of motion and muscle spasm are readily observed once attention is called to the involved portion where examination often reveals bony deformity in the nature of a kyphotic curve

Occasionally the *dissecting Pott s abscess* is the earliest clue to bony destruction The inflammatory swelling may point at the insertion of the *psoas muscle* just below Poupart's ligament in the thigh A *mediastinal abscess* may become apparent posteriorly or it may track along the course of the ribs and show itself on the anterior chest wall In the cervical region the abscess may be observed or felt as a *retropharyngeal collection* under which circumstances movement of the head is extremely painful and greatly restricted

Roentgenograms leave no doubt as to the extent and character of the affliction The destruction and deformity of the vertebral bodies is clearly apparent and the abscesses are often visible particularly on anteroposterior views of the thoracic spine

Pressure of the inflamed or edematous tissue may produce neurologic manifestations in the *spinal cord cauda equina* and *sensory* or *motor* roots In the most advanced stages the *Pott s paraplegia* may develop

TREATMENT—The treatment of spinal Pott s disease is the province of the specialist Prolonged immobilization on a convex frame is required until the process has become arrested Occasionally the natural processes may be aided by operative spinal fusion

Tuberculosis of the Hip—Tuberculosis of the hip constitutes 30 per cent of all articular tuberculosis Since the joint is deeply situated the manifestations of *pain* and *limitation of motion* with the *night cry* are most prominent Due to reference of the pain along the course of the obturator nerves *pain in the knee* is a fairly frequent complaint in hip involvement.

Radiographs reveal the narrowing of the joint space bone atrophy and destruction of joint surface The picture is of greatest importance in dif

ferentiating *Legg Calvé Perthes disease* (p 2027) in which there is no narrowing of the joint space and much less atrophy

Tuberculosis of the Knee —Tuberculosis of the knee occurs next in frequency to hip involvement In addition to pain and limitation of motion the swelling and effusion are readily noted *Aspiration of the joint* reveals fluid from which the *tubercle bacillus* should be recovered by *smear* or *guinea pig inoculation* (p 63) The *radiographic* appearances are similar to those described in the hip joint

Tuberculosis of the Foot and Ankle —In the older age group the foot and ankle are most commonly involved in tuberculous arthritis The clinical manifestations are those of a chronic monarticular involvement in a



Fig 0—Exte e t berc lo is of the ankle joint shown on the right in ol i g the ti fibula and astr lu which occurred n a patient who had a tuberculous kidney prostate epididym s and lu Amputation was performed through the middle of the leg Note e pec lly subchondral bo destruction Compare with normal on left

patient with known tuberculosis Aspiration yields fluid which contains the organism and radiographs reveal the characteristic destructive changes

Sacro iliac Tuberculosis —Sacro iliac tuberculosis is not too uncommon In its early stages it produces a syndrome of a *sciatic radiculitis* (p 1402) The diagnosis often does not become apparent until the appearance of an *abscess* which may track along the iliopsoas muscle to appear below Poupart s ligament in the thigh

Tuberculosis of the Joints of the Upper Extremities —Tuberculosis of the non weight bearing joints of the upper extremities is a milder type of arthritis that occasionally heals with preservation of some degree of motion The symptoms are those of a chronic arthritis with or without sig

Lewin The Foot and Ankle Lea & Febiger Publishers



Fig. 768.—Tuberculosis of hip.*



Fig. 769.—A, Tuberculosis of the knee with destruction of the articular surfaces. B, After an operative fusion of the knee joint.†

* Caldwell in Pullen, Medical Diagnosis.
† Chandler in Christopher, A Textbook of Surgery.

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Fig [illegible]0—Extensive tuberculosis of the ankle joint shown on the right involving the tibia, fibula and astragalus which occurred in a patient who had a tuberculous kidney prostate epididymis and lung Amputation was performed through the middle of the leg Note especially subchondral bone destruction Compare with normal on left

patient with known tuberculosis Aspiration yields fluid which contains the organism and radiographs reveal the characteristic destructive changes

Sacro iliac Tuberculosis—Sacro iliac tuberculosis is not too uncommon In its early stages it produces a syndrome of a *sciatic radiculitis* (p 1492) The diagnosis often does not become apparent until the appearance of an *abscess* which may track along the iliopsoas muscle to appear below Poupart s ligament in the thigh

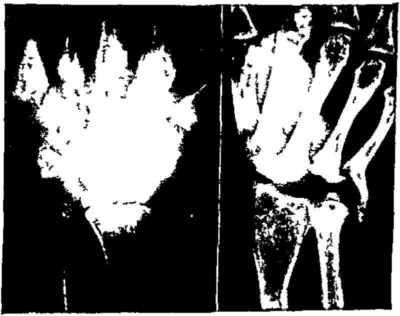
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nificant evidences of tuberculosis elsewhere in the body The diagnosis is established definitively by the recovery of the *organism* from aspirated fluid Radiographs offer most suggestive evidence

Tuberculous 'Rheumatism —Continental authors speak of a type of polyarticular arthritis thought to be due to the tubercle bacillus In all likelihood these are tuberculous patients afflicted coincidently with rheumatoid arthritis (p 2910)

Laboratory Findings —The diagnosis of tuberculous arthritis requires a demonstration of the presence of the *primary infection* (p 252) and evidences of hypersensitivity to the protein of the tubercle bacillus as revealed by the *Pirquet Mantoux* or *patch tests* These data suggest but do not prove that the arthropathy is tuberculous since other forms of arthritis are as common in the tuberculous as in the nontuberculous



A B

Fig 771 —*A* Tuberculosis of the carpus *B* One year after excision of the carpal bones (film reversed) *

Radiographs of tuberculous joints afford intimations of the nature of the process The characteristic findings include *diminution of the joint space* due to destruction of cartilage *effusion* and *swelling* of the soft tissues *atrophy of the bone ends* absence of evidence of new bone formation and a *ragged moth eaten appearance* indicating *bone destruction* The *practitioner recalls however that* the radiograph may be quite normal in the early stages of the disease

Unimpeachable evidence of the etiology of a tuberculous arthropathy is afforded by examination of the *aspirated fluid* and *histologic sections* of biopsied material The tubercle bacillus may be recovered directly from centrifuged joint fluid but when only a few organisms are present it may be necessary to inject the material into a guinea pig and wait six weeks

* Chandler in Christopher A Textbook of Surgery

for evidences of tuberculosis in the experimental animal The histologic appearance of biopsy material obtained from a small piece of joint synovia leaves little doubt as to the origin of the disturbance

Treatment —*The treatment of joint tuberculosis involves the institution* of general measures (p 266) and local therapy which requires the careful consideration of an orthopedic specialist The afflicted joint must remain *immobilized* for months and even years It is the aim of the physician to establish a firm bony *ankylosis* *Heliotherapy* (p 3794) seems to hasten the reparative process and assist in the healing of sinus tracts Streptomycin therapy (p 103) merits prolonged trial

Prognosis —The prognosis of tuberculous arthritis is dependent more upon the extent of the systemic infection than the amount of destruction in the joint The two conditions do not necessarily parallel one another since there may be extensive arthritis with minimal constitutional manifestations or minimal arthritis with overwhelming systemic disease The outlook is better in the non weight bearing joints of the upper extremities where recovery occasionally occurs with preservation of some degree of motion

CHAPTER 135

THE SKELETAL AND LOCOMOTOR SYSTEMS NEUROGENIC AND VASCULAR DISTURBANCES

NEUROGENIC DISTURBANCES

THE structures of the skeletal and locomotor systems may be affected by *psychogenic abnormalities* and by lesions of the *brain cord* and *peripheral nerves* Additionally the *nerve plexuses* and *peripheral nerves* are mechanically involved as the result of *orthopedic disturbances* as in the sciatic syndrome that accompanies certain of the spinal arthropathies

HYSTERICAL CONTRACTURES

The hysterical contracture is a manifestation of a *psychosomatic disturbance* (p 1344) which becomes manifest in the skeletomuscular system Following an accident with medicolegal implication the patient complains of *pain* usually in a joint and manifests wholly atypical *contractures* and *limitations of motion*

The suspicions of the physician are aroused by the personality makeup of the patient the disproportionate subjective manifestations in relation to objective findings and the atypical symptoms If a lawsuit is pending the physician finds himself on the horns of a dilemma If he testifies that there is insignificant pathology he earns the ill will of the patient and the immediate community If he corroborates the patient's extravagant statements he faces humiliation on the witness stand when questioned by a hostile attorney

It is a wise precaution to avoid a definite commitment in the suspected hysterical contracture particularly those that involve the spine ("railroad spine") since profound pathologic changes such as tuberculosis osteomyelitis and carcinomatous metastases may exist for a considerable length of time before x rays reveal positive evidence

CEREBRAL PALSY (SPASTIC PARALYSIS LITTLE'S DISEASE)

Cerebral palsy is a common congenital affliction that is characterized by impairment of *voluntary muscle control* and oftentimes by *mental de*

ficiency The extent of the involvement varies and may be manifest by a *monoplegia* a *hemiplegia* (p 1430) a *paraplegia* or a *quadriplegia*

Etiology —The frequent history of difficult and prolonged labor and the use of forceps has led many physicians to believe that cerebral palsy results from *intracranial hemorrhage* produced during the passage through the birth canal Besides this mechanism it is possible that a *defective development* or *agenesis* of the nervous system may also be a causative factor

In the adult cerebral palsy results from *vascular accidents* such a thrombosis and embolism from *inflammatory causes* such as encephaliti and meningitis or from *neoplasms* In these latter disturbances orthopedic

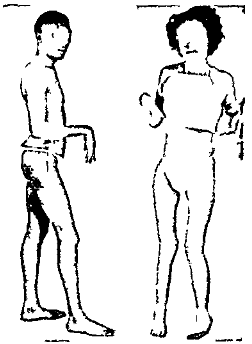


Fig —2 Fig —3

Fig —2 —Right spastic hemiplegia.

Fig —3 —Spastic diplegia with athetoid paralysis

treatment is of secondary importance and requires only the prevention of deformity

Clinical Manifestations.—Congenital spastic paralysis is due to an *upper motor neurone involvement* In consequence *there is spasticity of the affected muscle group* and *increase in the deep reflexes* The antagonistic muscle groups contract simultaneously with the agonist causing the patient to "*knot up*" when voluntary movement is attempted The *gait* is frequently disturbed by an *equinus* due to a contracture of the spastic calf muscles which overcome the weaker dorsiflexors of the foot. Similarly the adductors are stronger than the abductors at the hip and there

* Cabot: a Pullen, Medical Diagnosis

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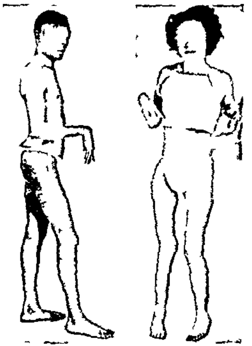


Fig 77 Fg 8

Fig 2—Right pa tic l m plegia

Fg 7 3—Spastic d pleg a w tl atheto d paraly is

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Caldwell in Pullen Medical Diagnosis

is a resultant *scissors gait* The legs cross over each other and the patient walks with difficulty his knees rubbing together tightly with each step The awkwardness is increased by a partially flexed attitude of the knees

In the upper extremities deformities develop because of the constant tension of spastic muscles The *shoulder* tends to become internally rotated and adducted The *elbows* are pronated and flexed the *wrist* and *fingers* flexed There is usually very little muscle atrophy and inconsequential sensory disturbance

Involvement of the basal ganglia and the extrapyramidal tracts leads to *athetosis* (p 1415) and *ataxia* (p 1415) so that there is extremely *marked*

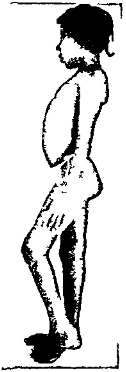


Fig 774



Fig 775

Fig 774—Anterior poliomyelitis with equinovarus deformity

Fig 775—Anterior poliomyelitis with paralytic clubfoot.*

incoordination of muscle movement The *mental status* is frequently impaired though certain of the afflicted are highly intelligent

Treatment—The treatment of cerebral palsy requires patient *training* and the exercise of all of the strength and character that the afflicted can summon If it is at all possible the physician should refer his patient to one who specializes in the care of spastic paralysis or to some institution where this work is done The surgical approach by correcting deformities and resecting nerves is of great value in certain selected cases Drug therapy using *curare* (p 3888) is not yet sufficiently developed for other than experimental use

* Caldwell, in Pullen Medical Diagnosis.

POLIOMYELITIS (INFANTILE PARALYSIS)

The general discussion of poliomyelitis is presented in the section on the *infectious diseases* (p 457) Here only the treatment of the involved neuromuscular structures will be presented

Orthopedic Treatment —In the *acute stage* of poliomyelitis the practitioner should summon an orthopedist specialist if it is at all practicable and feasible The first duties involve the relief of *pain* and *discomfort* and the *prevention of deformity* so far as is possible Prior to the introduction of the Kenny method of intensive physiotherapy it was the custom to *splint* the involved extremity until the acute muscle tenderness had subsided At the end of this time the splint was removed in order to institute gentle physiotherapy consisting of the application of *heat massage* and *active exercises* conducted under the supervision of an orthopedic surgeon or a trained physiotherapist

The *Kenny method* (p 463) advocates early and intensive physiotherapy by the application of *hot wet packs* and *early mobilization* This method has been widely publicized and initially met with considerable enthusiastic acclaim although more sober and objective observations are apparently more critical The introduction of a curare preparation (intocostrin) gives promise of relief of spasm and pain by a single injection repeated every few hours as indicated (p 465) Curare therapy is not without hazard and its use is best limited to fully equipped hospital wards

After the acute stage of muscle tenderness has subsided all are agreed that *graduated exercises* are highly desirable Under this type of therapy improvement in muscle strength may continue for a period of almost two years Meantime the paralyzed structures require support with plaster jackets braces splints and corrective shoeing

At the end of the two year period the residual paralysis can be assumed to be permanent It is now the duty of the practitioner to consult with the orthopedic surgeon concerning rehabilitation procedures which include *tendon and muscle transplantations arthrodesis* and various other types of *stabilization procedures* which require the most expert planning and execution

ERB S PALSY (OBSTETRIC PARALYSIS BIRTH PALSY)

Obstetric paralysis involves the *muscles* of the *upper extremities* and results from injury to the *brachial plexus* during *birth* It is most often seen when there is difficulty extracting the after coming head The paralysis is generally incomplete leaving some of the musculature intact

Clinical Manifestations —Erb s palsy is suspected when it is noted that the infant does not move one upper extremity The diagnosis is confirmed by examination which reveals a lower motor neuron type of paralysis with diminished deep tendon reflexes

Either the upper arm (Erb Duchenne) or the hand and fingers (Klumpke) may be involved As the child grows older contractures of the unopposed intact muscles develop The shoulder becomes internally rotated and adducted the elbow pronated the fingers flexed The affliction is not painful

Treatment —The treatment of obstetrical paralysis requires the services of the specialist In the beginning the extremity is elevated in the posi

is a resultant *scissors gait* The legs cross over each other and the patient walks with difficulty his knees rubbing together tightly with each step The awkwardness is increased by a partially flexed attitude of the knees

In the upper extremities deformities develop because of the constant tension of spastic muscles The *shoulder* tends to become internally rotated and adducted The *elbows* are pronated and flexed the *wrist* and *fingers* flexed There is usually very little muscle atrophy and inconsequential sensory disturbance

Involvement of the basal ganglia and the extrapyramidal tracts leads to *athetosis* (p 1415) and *ataxia* (p 1415) so that there is extremely *marked*

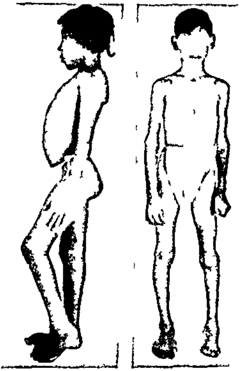


Fig 774 Fig 775

Fig 774 —Anterior poliomyelitis with equinovarus deformity *

Fig 775 —Anterior poliomyelitis with paralytic clubfoot.

incoordination of muscle movement The *mental status* is frequently impaired though certain of the afflicted are highly intelligent

Treatment —The treatment of cerebral palsy requires patient *training* and the exercise of all of the strength and character that the afflicted can summon If it is at all possible the physician should refer his patient to one who specializes in the care of spastic paralysis or to some institution where this work is done The surgical approach by correcting deformities and resecting nerves is of great value in certain selected cases Drug therapy using *curare* (p 3888), is not yet sufficiently developed for other than experimental use

* Caldwell in Pullen Medical Diagnosis

tion of abduction and external rotation This is accomplished by pinning the sleeve of the nightgown to the pillow or by the use of a brace Later in infancy and childhood *active* and *passive exercises* are utilized and *reconstructive surgical procedures* for the relief of contractures and deformities may be considered after consultation with the specialist

NEUROTROPHIC ARTHROPATHY (CHARCOT S JOINT)

Chronic diseases of the spinal cord that involve the *dorsal tracts* may lead to neuropathic disturbances of the bones and joints In all likelihood the skeletal disturbance is the result of multiple repeated traumas to the insensible joints leading to a severe osteoarthrosis (p 2855) Most frequently the neurotrophic arthropathy results from *tabes dorsalis* (p 1464) or *syringomyelia* (p 1505) Joint symptoms occur in 3 or 4 per cent of all tabetics and 20 per cent of those afflicted with syringomyelia

Clinical Manifestations —The neurotrophic disturbances may involve the bone in which case *atrophy* with thinning of the *cortex* results This may be sufficient to cause a *pathologic fracture* with little associated pain and prolonged healing More commonly the disturbed kinesthetic sensations produce abnormalities in the joints The articular cartilages and adjacent bones are worn away Extensive osteophyte formation is noted and loose bodies of various sizes rattle around in the joint so that it appears to be a mere bag of bones These *Charcot joints* are completely unstable usually free from pain and characterized by swelling due to effusion as well as periarticular infiltration There is palpatory evidence of the loose bony particles

The involvement is usually uniarticular the lower extremities are most often affected particularly the *knees* Syringomyelia is often associated with the disturbance in the non weight bearing joints of the upper extremities

Treatment —The treatment of the neurotrophic arthropathy is the province of a specialist An attempt is made to relieve the instability by employing *braces* or by the performance of *arthrodesis* (p 2813) In recommending the latter it is important to remember that healing may be difficult and unsatisfactory

BRACHIAL NEURITIS

Brachial neuritis may result from pressure of skeletal origin on the nerve trunks of the upper extremities The vulnerable points are the foramina in the spinal column and the site where the brachial plexus crosses over the first rib In the first instance the roots are compressed by osteophytes secondary to an osteo arthrosis or an osteo arthritis of the spine The neuritic pains are accompanied by restriction of motion in the cervical spine and radiographs reveal the origin of the disorder In these instances considerable relief is afforded by immobilization in a Shanz collar

The Cervical Rib or Scalenus Anticus Syndrome —The brachial plexus may also be compressed at the point where it crosses the first thoracic rib This may be caused by the presence of a cervical rib but more often is due to *spasm or contraction of the scalenus anticus muscle* This is often secondary to other adjacent lesions such as subdeltoid bursitis frozen shoulder or cervical osteo arthrosis



Fig 776—Obstetrical paralysis right shoulder*

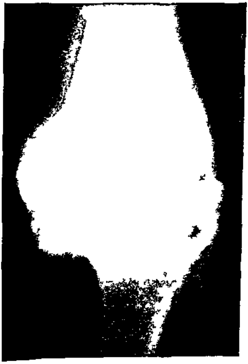


Fig 777—Charcot s knee joint*

* Caldwell in Pullen Medical Diagnosis

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DIFFERENTIAL DIAGNOSIS OF

Painless Swellings and Deformities of the Shoulder and Upper Extremities, Exclusive of Hands and Fingers

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Congenital Anomalies	
Cleidocranial Dysostosis	Absence of both clavicles (p 2824)
Partial Absence of Radius	With club hand and x ray deformity
Sprengel s Deformity	Elevation of scapulas (p 2823)
Birth Injuries and Other Traumas	
Cerebral Palsy	Usually with spastic paralysis (p 2948)
Erb s Obstetric Paralysis	From injury to brachial plexus (p 2951)
Mechanical Disturbances	Scoliosis with rotation deformity and prominent scapulas
Fractures and Dislocations	Get x rays before and after reduction.
Klumpke Birth Palsy	With deformities of hands and fingers (p 1451)
Psychogenic	Hysterical contractures (p 1367)
Neurogenic	
Birth Palsies	As above (p 1455)
Atrophies	Following amyotrophic lateral sclerosis hemiplegia, syringomyelia poliomyelitis cord tumors peripheral neuritis and ischemic paralysis Check neurologic status and refer to specialist.
Circulatory	
Hemophilic Hemarthrosis	With bloody effusion and family history of bleeding (p 1118)
Unilateral Edema	Usually secondary to mastectomy
Myopathies	Particularly progressive muscular dystrophy Note hypertrophy of musculature with weakness (p 2954)
Metabolic	
Vitamin D Deficiency	Producing deformities in rickets and osteomalacia Note therapeutic response to vitamin D (p 2850)
Osteo-arthrosis	Occasional involvement of shoulders and elbows Metabolic disturbance usually in obese middle aged patients with hypometabolism Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine
Gout	Occasional involvement of elbow Often with olecranon bursitis. Metabolic disorder of purin metabolism. Note high blood uric acid, tophi and sodium urate deposits (p 2867) Try therapeutic test with colchicine

CONTINUED

Infections and Inflammations	
Ganglion	Localized soft tis ue swelling U ually about wrist. Attempt rupture by pressure (p 2902) If unsuccessful consider excision.
Olecranon Bursitis	Swelling over elbow Alleviated by a piration and pressure bandage (p 2901)
Osteomyelitis	Pyogenic variety from penetration or by hema togenous dissemination (p 2930) Get blood culture Note x ray changes Start anti biot c therapy Prepare for surgery
Rheumatoid Arthritis	Frequent involvement of upper extremities In contrast to metabolic arthro es which more often involve weight bearing joints Inflam matory disturbance usually in ptotic adoles cents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increa ed sedi mentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete ther apeutic routine
Syphilis	Osteochondritis in prenatal and tertiary infec tion Note po itive serology and therapeutic respon e to penicillin (p 2937)
Tuberculosis	Occasional involvement of carpus and fingers Look for acid fast lesions elsewhere Note x ray changes Search for tubercle bacillus (p 2942) Obtain biopsy if necessary
Neoplastic	
Giant Cell Tumors	Involving epiphyseal ends With pain swelling and pathologic fracture (p 2840) Get x rays and refer to orthopedist for biopsy and treatment
Osteogenic Sarcoma	Usually involving shoulder and associated with pain (p 2843) Re er to orthopedic surgeon for biopsy and treatment.
Solitary Bone Cyst	Usually of long bones with pathologic fracture (p 2838)

The symptoms of the syndrome are those of a brachial neuritis The etiology is suggested when a cervical rib is demonstrable on the radio graph It must be emphasized however that the condition may exist with out a bony abnormality In this case the symptoms are exaggerated when the patient raises his thorax in inspiration and traction is made by the physician downward upon the extremity while the head is deviated to the opposite side Tenderness over the plexus in the base of the neck where it crosses the first rib is a constant finding The scalene may be palpably spastic Occasionally *pulse changes* are found such as diminution in vol ume or obliteration while traction is made on the arm with the chest in full inspiration or when the arm is lifted high in the air

The importance of making the correct diagnosis of scalenus anticus in volvement rests in the fact that *section of the muscle* is followed by com plete relief of the disturbance The operative procedure is the province of the orthopedic specialist since the technic is not so simple as would seem at first glance

SCIATICA

See p 1492

VASCULAR DISTURBANCES

Many of the manifestations of peripheral vascular disease are associated with manifestations in the extremities These include *lymphedema of the legs* (p 1400) *varicose veins* (p 3371) *phlebitis* (p 1124) *arterio sclerotic afflictions* (p 1030) *thrombo angiitis obliterans* (p 1029) and the *ischemic paralysis* of Volkmann These are elsewhere described since they are essentially problems in circulatory disorders

Included in these vascular disturbances are the osseous and articular afflictions associated with *caisson disease* (the bends') (p 1501) The bubbles of nitrogen that are released from solution in the blood stream may shut off the circulation to the bone and lead to an *aseptic necrosis* (p 2979) The infarcted areas are of variable size and have been known to result in the formation of *sequestra* almost as large as the entire bone *Joint symptoms* also occur and may not develop for a considerable time after the incident The interval is due to the development of progressive collapse of the necrotic articular structures

CHAPTER 136

TRAUMATIC DISTURBANCES OF THE SKELETAL AND LOCOMOTOR SYSTEMS

TRAUMATIC afflictions of the skeletal and locomotor systems constitute a considerable bulk of the material of private practice The present chapter deals with injuries of muscles tendons and joints other than dislocations and fractures Chapter 137 is devoted to a consideration of dislocations Chapter 138 deals briefly with the problems that arise when bone is broken and Chapter 140 details clinical manifestations of micro trauma resulting from postural strains static disturbances deformities and herniation These last by all odds the most frequent and least dramatic of orthopedic disturbances constitute daily experiences in the office of the general practitioner who must be alert to their recognition Failure of diagnosis results in discomfort and disability accentuated by neglect ill advised therapy and maltreatment especially under the aegis of strong arm miracle workers By contrast accurate recognition of the nature of the disturbance suggests palliative and often curative measures usually of great simplicity

CONTUSION OF MUSCLES

Muscle contusions are very frequent Usually those of minor degree require no medical attention Severe crushing injuries of muscle are accompanied by *shock* (p 932) If the skin is broken *secondary infection* may complicate the situation and with penetrating wounds evidences of *gas gangrene* (p 300) are sought in order that prophylactic treatment may be instituted at the earliest possible moment Myoglobinuria and uremia may occur in the crush syndrome when large masses of muscle are severely contused

RUPTURE OF MUSCLES AND TENDONS

The usual site of rupture of the muscle or tendon is at the *musculotendinous junction* Pathologic ruptures in debilitated patients occur as the result of minor trauma such as straining at stool or lifting on to a bedpan In these instances it is the abdominal muscle fibers that fracture

The common sites for rupture of musculotendinous structures are the plantaris in the calf the quadriceps where it attaches to the patella and the supraspinatus in the shoulder These accidents are associated with *excruciating pain* Often there is a *localized deformity* with a *sulcus* at the site of muscle separation and a *swelling* where the rolled up fibers have retracted This latter picture is most commonly seen with rupture of the *biceps* The injuries are also associated with *loss of voluntary power*

Rupture of the Plantaris Tendon—One of the most frequent muscle ruptures occurs in the *calf muscles* The injury is in actuality a tear of some of the fibers of the posterior calf muscles but it is commonly spoken of as a rupture of the plantaris tendon There is a history of an unexpected *strain* thrown upon the muscles with the onset of excruciating *pain* and

marked disability Patients frequently describe the condition as resembling the stab of a knife The patient is unable to stand on his toes there is a well localized spot of tenderness in the calf usually near the tendinous portion of the muscle and passive dorsiflexion is most agonizing

The foot is *strapped* in *equinus* with avoidance of weight bearing Hot applications prove comforting in most patients though some prefer an ice

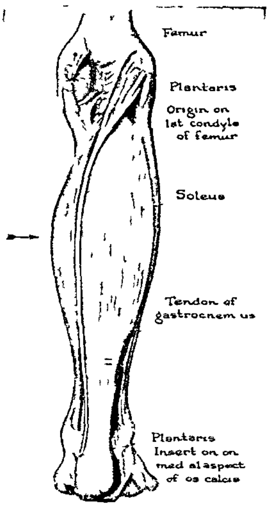


Fig 7 8—Plantaris tendon showing course along medial (inner margin) of leg Arrow indicates usual site of tearing or "rupture

bag After a few days the patient may become ambulatory at which time a lift is inserted in the shoe to relax the heel cord and an elastic bandage is wrapped around the calf Six weeks is about the usual duration of symptoms

Rupture of the Supraspinatus—The tendon of the supraspinatus muscle is an integral portion of the *capsule* of the *shoulder joint* It is interposed between the articular head of the humerus and the acromion thus form

ing a wall of the shoulder joint cavity Its upper surface is separated from the acromial process by the *subdeltoid bursa* (p 2904) It is frequently pinched between the bony structures especially during the vigorous use of the arm in full abduction Persons who subject their arm to this type of *activity expose the supraspinatus tendon to multiple injuries which result in minute hemorrhages* within the structure of the tendon These later are the sites for deposition of *calcium* The tendon surface becomes ragged abraded and frayed because of the calcific material producing the glass arm of the baseball player

The tears of the supraspinatus tendon usually occur when the structure is weakened It is more accurately a pathologic rupture of the capsule of the shoulder joint The actual injury occurs during abduction effort and is announced by a sudden *sharp pain* and *immediate disability* in the

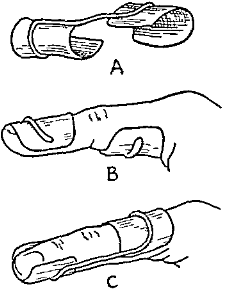


Fig 7 9—Metal or plastic splint for use in fractured finger especially useful if a wound is present

shoulder There is a tender spot over the point of the fracture and occasionally a *sulcus* can be felt Abduction cannot be voluntarily initiated from the side but once the arm is passively abducted for the first 10 or 20 degrees the motions can be voluntarily continued At about 90 degrees there is a painful jog as the torn portion of the supraspinatus disappears beneath the acromion and then from there on abduction is again relatively painless As the arm is brought down once more into the fully abducted position there is another painful jog at about 90 degrees as the torn portion of the capsule once more emerges from under the acromion These are the classical signs but any or all may be absent

Minor degrees of disability may be treated by *immobilization* in abduction Major degrees require open operation and suture of the tendon This procedure is distinctly the province of the orthopedic specialist

Moorhead, Clinical Traumatic Surgery

Baseball Finger —The mallet or baseball finger is an avulsion of the insertion of the *extensor apparatus* from the *terminal phalanx* of the finger The injury may or may not be associated with a *chip fracture* of a small triangle of bone The usual mechanism of the injury is that of having the ball carom off the tip of the finger

Treatment requires the plaster of paris maintenance of the distal interphalangeal joint in hyperextension while the proximal interphalangeal joint is held in flexion This position absorbs the pull of the extensor apparatus and releases the tendon beyond this point so that the avulsed fragment is relaxed and permitted to drop back into place Immobilization must be continued for six weeks

TRAUMATIC MYOSITIS OSSIFICANS

Bone may form within muscle following an injury The pathologic mechanism is an organization and ossification of the hematoma that is produced by the trauma The most frequent site of traumatic myositis ossificans is the region of the *elbow joint* In this situation it most frequently follows *fractures that have been treated by stretching and passive* motion A similar process occurs within the *pectoral muscle* of soldiers and results from the recoil of the gun

The condition does not require surgical removal unless local symptoms of pain are sufficiently severe to warrant relief

ACUTE TRAUMATIC ARTHRITIS

Acute injury to a joint is followed shortly by a *synovial reaction* which results in swelling effusion tenderness and limitation of motion In most instances the condition subsides spontaneously with complete return of function In the more severe examples the initial trauma sets up a persistent inflammatory process Under these circumstances some other contributing factor must be uncovered In certain instances the acute episode points merely to the presence of a more fundamental *postural defect* (p 3055) Again the injury may provide a place of least resistance for the development of an *infectious arthritis* (p 2905) or a *tuberculous invasion* (p 2939) In joints such as the knee there may be some permanent damage to the *internal structures* (p 2962) Finally the acute accident may serve to call attention to a pre existing *osteo arthritis* (p 2855) or *rheumatoid type of arthritis* (p 2910)

Treatment of acute traumatic arthritis is relatively simple If the effusion is great or there is a possibility of hemorrhage *aspiration* is advocated in order to limit postoperative adhesions and relaxation of the capsule Under other circumstances a simple splint is required for immobilization

INTERNAL DERANGEMENTS OF THE KNEE JOINT

The common internal derangements of the knee joint are lesions of the semilunar cartilage rupture of the cruciate ligament loose bodies (joint mice) osteochondritis dissecans and pinching of the infrapatellar fat pad

Lesions of the Semilunar Cartilages —Lesions of the semilunar cartilages are the most frequent internal derangements of the knee Because it is more firmly attached *to the internal lateral ligaments of the* knee the internal cartilage is more frequently involved and it is usually torn when

that ligament is severely injured The usual type of injury productive of this condition is a combination of external rotation of the leg upon the femur at the same time that the knee is deviated into valgus The entire *cartilage or its anterior portion is torn or it may be split longitudinally* producing a bucket handle tear

Clinical Manifestations — At the time of the accident the *pain* may be so severe that the patient falls to the ground When he arises he finds he cannot walk upon his leg There is a rapid *effusion of blood* into the joint and marked tenderness is localized to the inner aspect Complete extension of the knee is impossible if the cartilage is interposed between the articular surfaces Flexion is also limited and if the lateral ligaments are torn there is instability of the entire knee joint

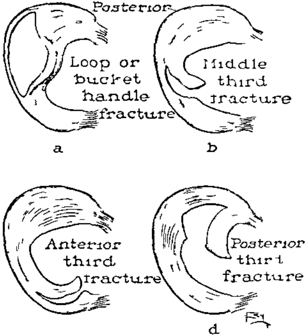


Fig 80 — Types of fracture of internal semilunar cartilage

Treatment — The dislocated cartilage may spontaneously return to its normal location or it may be reduced by manipulation The successful method of *manipulation* for internal cartilage dislocations requires that the knee be successively flexed abducted externally rotated and then suddenly internally rotated and extended The external cartilage is replaced by flexion adduction internal rotation and then sudden external rotation and extension If the procedure has been successful motions immediately become more free and extension is no longer limited The knee *joint* should be immobilized for at least three weeks in a long leg plaster Quadriceps tightening exercises are practiced throughout the period of immobilization

If there is *persistence of symptoms or recurrent dislocation an arthrotomy* (p 2813) for removal of the displaced cartilage is indicated

Henderson in Christopher's Textbook of Surgery

If the joint effusion is considerable after the reduction of the dislocation, aspiration should be practiced to remove the blood and prevent the formation of adhesions

Rupture of the Cruciate Ligaments—The cruciate ligaments are ruptured by severe injury to the knee This injury may be accompanied by *rupture of the lateral ligaments* and *fracture of the tibial spine* (p 3038) When the anterior cruciate ligament is torn there is anteroposterior instability of the knee joint and the tibia can be displaced forward on the femur Posterior ligament tears result in a backward instability

Isolated tears of the cruciate ligaments produce little disability if the lateral ligaments are intact Operative treatment is indicated only if it is necessary to repair or reconstruct the ligaments

Loose Bodies (Joint Mice)—Joint mice most often found in the knee probably form from osteophytes which have broken off and become loose from the proliferation of the synovial villi with formation of cartilage or from segments of articular cartilage that have been separated from the underlying bone as in *osteochondritis dissecans*



Fig 781—Loose body in osteochondritis dissecans, arising from internal condyle

Often the patient notices the loose body which may be moved around in the knee joint If the joint mouse becomes interposed between the articular surfaces there occurs a severe and immediate pain that is analogous to that of the displaced cartilage Effusion and limitation of motion (locking) accompany the pain Radiographs reveal calcified loose bodies with considerable clarity

With repeated locking of the joint and painful episodes resulting from joint mice an *arthrotomy* (p 2813) is justified with removal of the offending particles

Osteochondritis Dissecans—Osteochondritis dissecans is a joint affection probably due to a *local disturbance of blood supply* As a result there is a separation of a fragment of the cartilage with its underlying bone It is most frequently found on the *inner condyle of the femur* but also is observed on the articular surface of the *patella* or elsewhere in the *knee joint*

* Henderson in Christopher A Textbook of Surgery

Loose bodies that are accidentally discovered and those which cause no symptoms require no treatment If there is persistent pain or disturbance in function an arthrotomy should be performed and the loose body removed

Pinching of the Infrapatellar Fat Pad—Occasionally the infrapatellar fat pad becomes hypertrophied and is pinched between the articular surfaces of the joint during full extension This disturbance results in symptoms similar to those noted with other internal derangements of the knee

If the discomfort is sufficient the fat pad requires operative removal

HUMERAL EPICONDYLITIS (TENNIS ELBOW)

The tennis elbow is noted in patients who have used the forearm for excessive *pronation* and *supination* The affliction is characterized by an *aching pain* over the outer side of the elbow radiating down the radial side of the forearm It is aggravated by use of the extremity particularly in motions that require pronation and supination The condition is chronic and may last for months but eventually spontaneous recovery is observed

The pathology is thought to be a *partial tear* of the origin of the *extensor muscles* of the wrist from the *lateral epicondylar ridge* of the *humerus* There is well localized tenderness over this point with exacerbation of pain when the extensors of the wrist are placed on the stretch

Treatment consists in *manipulation* of the elbow after preliminary *massage* of the affected area The wrist is turned in flexion the elbow is completely extended and while the extremity is maintained in this position the elbow is forcibly deviated toward a position of varus This is repeated with the arm in pronation and supination The object of the procedure is to stretch or tear the inflamed origin of the wrist extensors Manipulation is repeated at three or four day intervals until the condition has subsided If symptoms are persistent *procaine injections* (p 2814) are tried although it may be necessary eventually to have the orthopedic specialist strip the extensor origin

SNAPPING HIP

When that portion of the ilio tibial band of the fascia lata which runs over the greater trochanter of the femur is unduly mobile it may slip fore and aft on the trochanter to the accompaniment of a disconcertingly loud *snap* The band may be felt and sometimes seen to slip back and forth when the thigh is rotated internally and externally while the hip is in adduction

The patient may be assured that the condition is of no moment and treatment is unnecessary If it becomes too annoying operation should be done

CHAPTER 137

TRAUMATIC DISTURBANCES OF THE SKELETAL AND LOCOMOTOR SYSTEMS DISLOCATIONS

JOINT dislocation occurs when there is displacement of the articular surface Incomplete or partial dislocation is termed subluxation *Simple dislocation is one in which the joint cavity is not exposed to contamination through communication by way of broken skin or mucous membrane Compound dislocation* is one in which the joint communicates with the external environment and hence is exposed to contamination or infection In *fracture dislocation* joint displacement is associated with a break in the adjacent osseous structures *Pathologic dislocations* occur in weakened joints from inconsequential trauma

For the protection of all concerned the *practitioner should* insist upon x rays of all dislocated joints before and after reduction The more frequently encountered and simpler dislocations may be managed by manipulation without the assistance of the specialist surgeon or orthopedist More *serious injuries* such as those that involve the spine with the danger of compression of the cord are best given only first aid treatment reserving manipulative endeavors until after the patient has been hospitalized x rayed and prepared by expert assistants under optimum conditions

THE TREATMENT OF DISLOCATIONS

The general principles that prevail in the treatment of the fracture apply also to the dislocation The practitioner is urged to read with particular care the recommendations and warnings elsewhere summarized (p 2984) Presuming that the patient has an obvious dislocation as for example of the shoulder the undernoted routine is recommended

1 If possible transport the patient to office or hospital for preliminary x ray
2 Protect the dislocated member by gentle handling Give immediately a *hypodermic of dilaudid 2 mg* (1/32 *grain*) *morphine 15 mg* (1/4 grain) or Demerol 50 mg (? grain) If the dislocation is compounded administer penicillin prophylactically in an initial dose of 100 000 units and consider the advisability of injecting tetanus gas gangrene antitoxin N N R as advised in the management of the fracture (p 2984)
3 If preliminary x ray shows no evidence of fracture and the dislocation is temporomandibular cervical interarticular humeral sternoclavicular acromioclavicular radial olecranonal carpal digital metacarpophalangeal lower femoral patellar tibial tarsal or metatarsal prepare for reduction without summoning the consultant
4 Except under unusual circumstances avoid attempted reduction of dislocations of atlas axis cervical spine pelvis radiohumeral ar

ticulation or hip These are best managed by the orthopedist or the consulting surgeon who should be summoned also if the dislocation is *compounded irreducible recurrent* or *pathologic*

5 When reduction is attempted whether by choice or necessity the patient is entitled to anesthesia using procaine locally or general anesthetization with sodium pentothal drop ether nitrous oxide or chloroform Needless to say general anesthesia must be given by a competent assistant preferably a colleague

6 Following reduction and the application of plaster a check x ray is *required to ascertain that there has been accurate restitution to normal* A survey is conducted to determine the integrity of the

TABLE 153—MANIFESTATIONS AND TREATMENT OF DISLOCATIONS AND SUBLUXATIONS OF JAW SPINE AND PELVIS

Site	Clinical Manifestations and Treatment
Temporomandibular Joint	Forward displacement of condyle of mandible Patient unable to open mouth Reduce by pressing lower molars downward Protect thumbs with padding Give anesthesia if necessary Apply four tailed bandage for t s days Give liquid diet
Cervical Interarticular Facets	Subluxation produces acute crick in neck Marked limitation of motion Inability to approximate ear to shoulder Reduce while patient is recumbent by hyperextension of head lateral flexion and rotation (p 006) Apply padded collars for several days
Atlas Axis and Cervical Spine	Avoid examination and manipulation unless respiration is impaired Transport recumbent In emergency attempt reduction by traction and hyperextension (p 3009)
Dorsal and Lumbar Spines	Avoid examination and manipulation Transport in prone position Do not support head with pillow Prevent side rocking during trip Phone ahead for preparation of operating room and consultation with surgeon or orthopedist In emergency attempt reduction by traction and hyperextension (p 3009)
Pelvis	Transport as in dislocation of spine Refer to specialist Look for evidences of injury to rectum and bladder
Spondylolisthesis	Forward luxation of vertebra Usually associated with defect of neural arch Most frequent at level of fifth lumbar or first sacral Sharply localized pain and tenderness Get anteroposterior and lateral x rays Refer to orthopedist for spine fusion if symptoms are severe

soft parts particularly relative to blood supply and innervation and the possible presence of effusion into the joint

7 With continued or recurrent pain the practitioner must not administer more opiate but he must look for local difficulties The reduction may have been incomplete dislocation may have recurred or a tense hydrarthrosis or hemarthrosis may require aspiration

DISLOCATION OF THE TEMPOROMANDIBULAR JOINT

Dislocation of the temperomandibular joint occurs when the condyle of the mandible becomes displaced forward This accident may be brought

about by trauma from a blow or it may follow a wide yawn Laxity of the ligament is a predisposing cause

The *diagnosis* is suspected when the patient cannot close the mouth When the condyles are palpated the articular surfaces can be felt anterior to the fossa In unilateral dislocation the chin is deviated to the side opposite the lesion

Reduction is accomplished by inserting the well padded thumb into the mouth and pressing downward on the lower molars to enable the condyles to clear the eminentia articularis The condyles may then be gently slid back into the fossae Where there is considerable pain and spasm general anesthesia may be required A four tailed bandage is employed for immobilization for at least ten days The patient is put on a fluid diet

CHRONIC SUBLUXATION OF THE TEMPOROMANDIBULAR JOINT

The temperomandibular joint is subdivided into two parts by horizontal articular disks When the jaw is normally open the mandibular

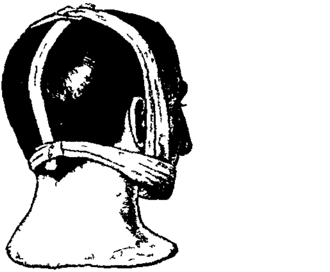


Fig 782 —Four tailed bandage for fractured jaw

condyle slides forward on the disk Exaggeration of this motion produces clicks and snaps which may be painful The joint may truly dislocate

Chronic subluxation is usually associated with *malocclusion*

In the majority of instances no therapy is required When the condition interferes with mastication and is productive of pain the patient should be referred to the specialist Attempts have been made to relieve the condition by injecting *sclerosing solutions* into the joint

DISLOCATIONS OF THE SPINE

Dislocations of the spine occur in the cervical interarticular joints the cervical spine the atlas the dorsal and lumbar spines and the pelvis

Subluxation of the Cervical Interarticular Joints—Subluxation of the cervical interarticular joints occurs with great frequency It is probably the

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mechanism of the familiar crick in the neck The usual history is that of sudden pain associated with a twist or jerk of the neck At times this occurs when an automobile comes to a sudden stop Another familiar example is twisting of the head when waking from sleep

The patient complains of sudden pain in the neck and stiffness The pain radiates down shoulder and arm Deep *tenderness* is elicited over the lateral processes in the neck Motion is greatly restricted by *muscle spasm* The ear on the affected side cannot be approximated to the shoulder Ordinary roentgenograms are of little value The diagnosis is made from the characteristic history and findings

To accomplish *reduction* the patient lies recumbent on the table the head projecting beyond the edge of the table into the lap of the operator

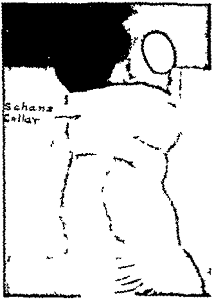


Fig 83.—Schanz collar Stockinet 8 inches (about 20 cm) wide and 72 inches (nearly 2 meters) long is employed filler consists of twelve layers of 8-inch sheet wadding cotton tape is used to tie start under chin wrapping snugly around neck form to maintain necessary degree of hyperextension *

The head is hyperextended flexed laterally and rotated until dislocation *is suddenly* corrected

An excellent type of immobilization for sprains of the cervical vertebrae is the *Schanz collar* which is a very bulky encircling jacket made of alternate layers of sheet wadding and flannel This is quite comfortable and except for its unsightly appearance is satisfactory in every way for most sprains of the neck It is applied for several days after reduction If subluxation recurs orthopedic specialist services are required

When a more permanent removable type of support is desired a leather *neck collar* may be manufactured at most brace shops to the patient s individual measurements

* Manual of Orthopedic Subjects National Research Council

Dislocation of the Cervical Spine—Dislocation of the cervical spine is a serious accident since injury to the spinal cord is frequent Nerve roots are damaged and *paraplegia* may be present

Dislocation of the cervical spine results from the same force which causes subluxation The inferior articular facets of the vertebra above slide completely over the superior articular facets of the vertebra below The

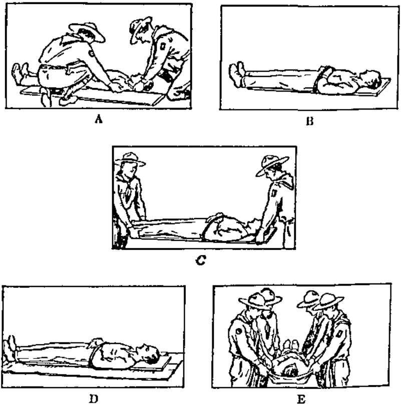


Fig 784—Method of transportation in broken neck *A* Place board or plank beside injured so that the board extends four inches beyond the injured's head One man grasps injured at shoulder and hip and places his foot against the board to prevent board from sliding a second man steadies the head and neck between his hands On command the injured is slid as one piece onto the board

B The arms of injured are folded and the sleeves pinned together A strap is passed about the injured and the board to prevent the injured from sliding off

C The injured may then be picked up by grasping board at head and feet

D If no stretcher is available the injured resting on the board may be lifted onto a blanket and the blanket used as a stretcher

E The blanket is then grasped by four people and the injured can then be transported safely

facets become locked in this abnormal position They cannot be unlocked by extension alone

The specialist orthopedist is to be consulted *Traction* is necessary to separate the vertebrae and permit them to slide back into place Additional injury to the cord may result from inept manipulation

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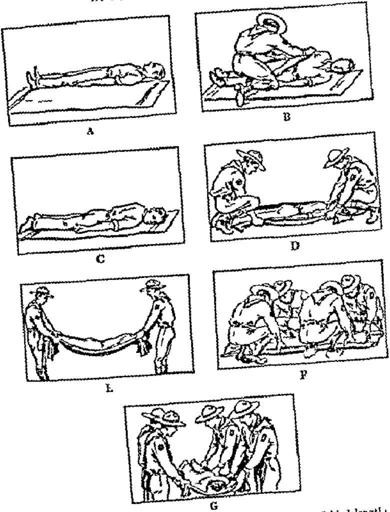


Fig 85—Transportation in broken back *A* Place a blanket folded lengthwise beside the injured

B Injured should be grasped at shoulder and hip and slowly and gently rolled over onto blanket so as to lie face down with head turned to one side

C Injured lying on blanket, face down ready to be carried to a stretcher or similar firm support

D Two men carry—a four man carry is better One stands at one end and grasps the blanket just above the level of the shoulders the second man stands at other end and grasps the blanket at the level of the injured's knee

E On command both lift together

F Four men carry Two men squat on either side of the injured The blanket is grasped just above the level of the shoulders opposite the chest the hips and at the ankles

G On command all lift together

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Dislocation of the Atlas—Dislocations of the atlas are generally projected forward If they are more than minor in extent the *cord* becomes *compressed* between the posterior ring of the atlas and the odontoid process of the axis Death usually results

Because of the danger of further injury to the cord during manipula tion *reduction* requires the assistance of an expert in an institution prop erly equipped for the care of this type of injury

Dislocations of the Dorsal and Lumbar Spines.—Dislocations of the dorsal and lumbar spine are rare but severe injuries They are always accom panied by fracture of the *articular facet* and frequently of the *bodies* of the vertebrae as well *Cord injuries* are often associated

These traumas are in the province of the specialist

Dislocation and Fracture of the Lateral Articular Facet—Dislocations and fractures of the lateral articular facets are rare and difficult to manage No general rules can be formulated for their care Decision as to the type of manipulation necessary for reduction can be determined only after the roentgenograms have been studied carefully

Dislocations of the Pelvis—Isolated dislocations of the symphysis pubis and sacro iliac joints rarely occur Fractures of the pelvic ring (p 3003) are more often associated with contralateral dislocations These may be overlooked unless particularly inspected and sought When there is a



Fig 786—Spondylolisthesis Note the defect in the pedicles of the last lumbar vertebra, which allows the vertebral body to slip forward upon the sacrum

separation of the symphysis with an intact bony pelvis ring there must be a sacro iliac displacement and vice versa

Pelvic dislocations may be reduced by *manual manipulation* Gener ally anesthesia is to be employed if necessary *Immobilization* is main tained by a *double plaster spica* or by encircling traction

SPONDYLOLISTHESIS

Spondylolisthesis is a *forward luxation* of a vertebra upon the one below *Reversed* spondylolisthesis implies a *posterior luxation* In spon dylolisthesis there is an *associated defect in the neural arch* which per mits the body to slip away and slide forward even though the posterior articular facets are securely fixed The most frequent lesion is a spondylo listhesis of the fifth lumbar on the first sacrum The etiology of the defect may be congenital but the possibility of the traumatic initiating cause for the acute slip is recognized

Diagnosis—The pain of spondylolisthesis is usually localized in the lumbar sacral joint with well localized tenderness There may be a visible *dimple* in this area marking the forward projection of the spinous process of the fourth lumbar vertebra Pain may radiate down either extremity and

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local signs of spasm and limitation of motion are present The roentgenogram reveals the pathology

Treatment —Treatment in severe cases requires *fusion of the spine* from the fourth lumbar to the sacrum Conservative therapy with braces and exercises may afford some relief

TABLE 154 —CLINICAL MANIFESTATIONS AND TREATMENT OF DISLOCATIONS OF THE UPPER EXTREMITY

Site	Clinical Manifestations and Treatment
Shoulder	These constitute more than 50 per cent of all dislocations Most frequently subcoracoid but may be subglenoid or intraspinous Look for associated injury to circumflex nerve supplying deltoid X ray for possible accompanying fracture Reduce under procaine or general anesthesia by straight traction Immobilize by swathe for two to three weeks Begin finger and wrist exercises at once Repeated dislocations require surgery to create check ligament from long head of biceps
Sternoclavicular	Usually anterior due to rupture of anterior capsule. Replace by pulling shoulder upward and backward Immobilize in corrected position for 4 weeks with clavicle splint (p 2974)
Acromioclavicular	With tear of acromioclavicular or coracoclavicular ligaments Drooping of shoulder best seen from behind Correct by bringing clavicle down to acromial process Apply clavicle splint. Immobilize for 1 month
Elbow	Usually posterior Often associated with chip fracture of coronoid process Reduce by traction in line of humerus, with elbow straight After reduction make neurologic survey for nerve damage Apply posterior molded splint with elbow at 90 Immobilize for 3 weeks.
Radiohumeral	Frequently associated with fracture of shaft of ulna (Monteggia) Produces angulation or [illegible] erriding (p 3027) Reduce by manipulation and traction with elbow in varus Immobilize for 3 weeks with elbows flexed at 90
Radial Head	Subluxation in children between ages of 2 and 4 result of forcible pulling Note limitation of supination and disability Reduce by supinating forearm while applying pressure against radial head. Immobilize in sling for several days
Carpus	Almost always associated with fracture Carpal lunate occasionally dislocates forward as result of fall on outstretched hand Reduce by exerting strong traction on fingers and pressing dislocated bone into normal situation Immobilize for 3 weeks in slight flexion Obtain x rays
Fingers	Reduce by traction and manipulation Immobilize in extension for several days
Thumb Metacarpo-Phalangeal	Metacarpal shaft driven through joint capsule between flexor tendons (button hole dislocation) Reduce by looping gauze bandage around phalanx Make traction in direction of hyperextension while face of phalanx is pushed distally to metacarpal head before phalanx is flexed Employ general anesthesia if necessary Immobilize in moderate flexion for 2 weeks

DISLOCATIONS OF THE SHOULDER

The shoulder joint permits the widest range of motion of any joint in the body and has the least inherent bony stability depending upon mus

cular control for its integrity Consequently shoulder dislocations constitute more than 50 per cent of all dislocations

The most frequent type of dislocation is the subcoracoid type in which the humeral head lies beneath the coracoid process *Subglenoid* and *infraspinous (posterior) dislocations* also occur Associated *nerve injuries* es

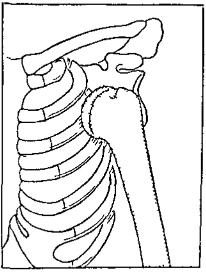


Fig 787—Infraclavicular dislocation of shoulder

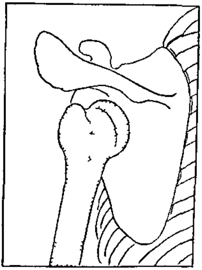


Fig 788—Subspinous dislocation of shoulder

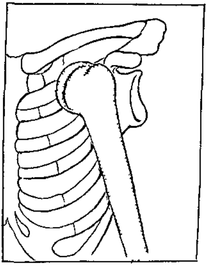


Fig 789—Subclavicular or intracoracoid dislocation of shoulder *

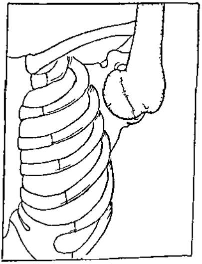


Fig 790—Erecta dislocation of shoulder (very rare) *

pecially to the circumflex nerve supplying the deltoid muscles are fairly common and should always be sought Accompanying fractures are frequently present so that roentgenograms are necessary before and after reduction

The *diagnosis* of subcoracoid dislocation is not difficult The normal

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rounded outline of the shoulder is lost The head may be felt in the abnormal position Motions are painful and restricted The patient often supports the slightly abducted injured extremity with the other hand

Reduction usually may be accomplished under procaine anesthesia (p 2814) Occasionally general anesthesia is required especially if the dislocation is of some hours durations The *Kocher maneuver* may be tried if there is no associated fracture The elbow is flexed to the right angle and the humerus is slowly rotated externally to its full limit (within 15 degrees of the coronal plane) The elbow is then carried across the chest toward the opposite side keeping the humerus externally rotated and levering it

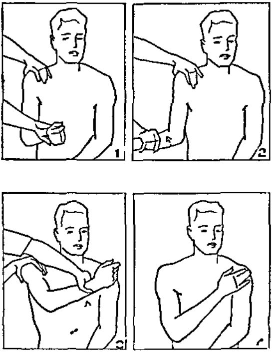


Fig 791 —Kocher method of reduction of dislocated shoulder *1* Arm at side (adducted) with elbow flexed *2* Arm abducted and externally rotated this is the essential step *3* Arm adducted and internally rotated *4* Final position Note that hand of injured side can be placed on the opposite shoulder This is Dugas test

against the thoracic cage Finally the humerus is rotated internally If the dislocation has been reduced the hand can now be placed against the opposite shoulder If the Kocher method is performed too energetically a spiral fracture of the humerus may result in the elderly individual

The *heel in axilla* method requires that the operator place his stockinged heel in the patient s axilla for counter traction Prolonged steady traction is exerted downwards upon the extremity Gentle rotatory movements aid in the reposition

If enough assistance is available an excellent method is to make *traction* by means of sheets One sheet is placed in the axilla with the assistant

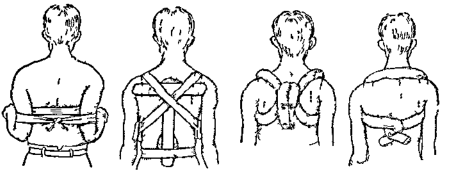
making traction upwards and laterally while another is wrapped around the chest with traction toward the unaffected side The surgeon then pulls downward and slightly laterally on the arm Traction should be steady strong and prolonged Reduction may take fifteen minutes or more

After reduction immobilization is secured by a sling which is bound to the body by a swathe to maintain the arm and forearm against the thorax Finger and wrist exercises are begun at once In two or three weeks shoulder and elbow motion is started

Recurrent Dislocation of the Shoulder—Repeated dislocations may be the result of inadequate treatment or immobilization of the first dislocation or failure of the joint capsule to heal Recurrent dislocation is best treated by the Nicola operation of creating a check ligament from the long head of the biceps

STERNOCLAVICULAR DISLOCATION

Sternoclavicular dislocations are usually anterior due to rupture of the anterior capsule *Replacement* is easily effected by pulling the shoulder



A B C D

Fig 792—Fracture of clavicle showing types of splintage *A* Bandage fasting arms behind the back *B* Clavicle cross *C D* Gauge-covered roll of cotton

up and back *Immobilization* in this position is necessary for four weeks and may be secured by a Roger Anderson or Bohler clavicle splint Recurrent dislocation may not be accompanied by any disability If it is open *fascial repair is indicated*

ACROMIOCLAVICULAR DISLOCATION

In minor degrees of acromioclavicular dislocation only the *acromioclavicular* ligaments are torn In more severe injuries the strong *coracoclavicular* ligaments are ruptured There is a visible gaping at the acromioclavicular joint with a dropping of the shoulder best seen from behind as an elevation and projection of the outer end of the clavicle

The injury is treated by bringing the clavicle down to the acromion process by a Bohler *fractured clavicle splint* Immobilization is continued for one month

An unreduced acromioclavicular dislocation may cause no symptoms especially in the presence of good musculature If a disability does exist *fascial repair* of the coracoclavicular *ligament may be necessary*

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DISLOCATIONS OF THE ELBOW

The usual elbow dislocation is *posterior* the ulna carrying the radius backwards with it There is frequently an associated *chip fracture* of the *coronoid process* (p 3024) The normal relationship of the olecranon to

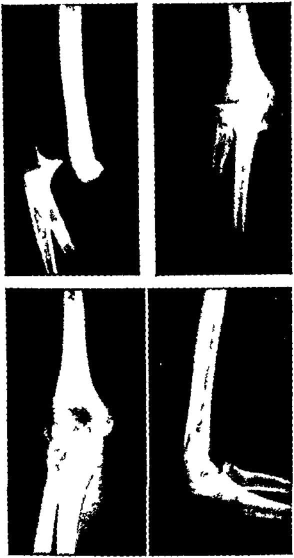


Fig 793 —Dislocation of elbow before and after reduction *

the internal and external humeral condyles (an isosceles triangle with the elbow at 90 degrees) is disturbed and the olecranon projects posteriorly

Reduction should be preceded by a careful neurologic check for nerve damage It is then easily accomplished by *traction* in the line of the humerus with the elbow straight A posterior molded *plaster splint* is

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then applied with the elbow at 90 degrees Immobilization is continued for three weeks After treatment includes *active exercises* with avoidance of forceful massage and manipulations

Dislocation of the Radiohumeral Joint—Radiohumeral dislocation is frequently associated with a *fracture of the shaft of the ulna* (p 3026) causing angulation or overriding The presence of either injury suggests the other (Monteggia fracture)

The dislocation is reduced by *manual manipulation* and *traction* with the elbow in varus Three weeks of *immobilization* with the elbow flexed at 90 degrees will afford sufficient time for the orbicular ligament to heal

Subluxation of the Radial Head in Children—Children between the ages of two and four years frequently complain of pain and inability to use the elbow after having been pulled along forcibly by the hand The chief clinical finding is marked *limitation of supination* and unwillingness to use the extremity Roentgenograms are normal

In these cases the radial head is thought to have been pulled down into the orbicular ligament Relief is attained by gently *supinating the*

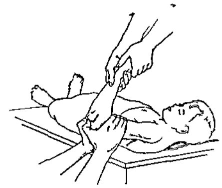


Fig 794—Reduction of dislocation of elbow *

forearm through the normal range while the operator presses gently against the radial head with his thumb A click may be felt and relief is immediate A sling should be used for several days

DISLOCATIONS OF THE CARPUS

The commonest dislocations of the wrist are associated with fractures and are discussed elsewhere (p 3028) The only other dislocation of any frequency *is the forward dislocation of the carpal lunate* This is generally caused by a fall on the outstretched hand The lunate is popped out like a pea from a pod making pressure on the flexor tendons and the median nerve It can be felt as a small tender mass in the center of the palmar aspect of the wrist

Reduction is usually accomplished if the space between the capitate and the wrist is opened up by strong *traction* on the fingers before the lunate is replaced by *manual manipulation* In old cases operative replacement or removal is necessary *Immobilization* in a plaster case for three weeks in neutral position or slight flexion should follow the reduction

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DISLOCATIONS OF THE FINGERS

Most dislocations of the fingers are easily reduced by *traction and manipulation* Indeed they are often reduced in this manner by the amateur bone setters found on every playing field However there are certain types of dislocation in which this method fails because of soft tissue interposition

Dislocation of the Metacarpophalangeal Joint of Thumb (Buttonhole Dislocation)—Dislocation of the metacarpophalangeal joint of the thumb results

TABLE 15 —CLINICAL MANIFESTATIONS AND TREATMENT OF DISLOCATIONS OF THE LOWER EXTREMITY

Site	Clinical Manifestations and Treatment
Hip	See also Congenital dislocation p 28 8 Acquired injury usually results of impact of knee against dashboard in automobile accidents Head of femur driven backward over posterior rim of acetabulum Thigh flexed internally rotated and adducted with shortening of limb Head of femur felt as prominence in buttocks Reduce under general anesthesia with patient recumbent Flex thigh with knee at 90 Lift head of femur over acetabular lip and back into acetabulum while assistant steadies pelvis Get x rays Look for injuries of sciatic nerve Immobilize for 1 month in plaster spica with hip in neutral position and knee slightly flexed After several months reexamine patient for possible aseptic necrosis *of head of femur due to interruption of blood supply by tear of round ligaments* and capsule
Knee	Usually associated with fracture of tibial spine Reduce by *manipulation* under general anesthesia Examine for accompanying nerve and vascular injuries before immobilization in long leg plaster for three months Order quadriceps exercises throughout period of immobilization
Patella	*Usual displacement over lateral femoral condyle* May be accompanied by tear of capsule and hemarthrosis Reduce manually with knee fully extended Immobilize in walking plaster for 4 weeks Start quadriceps exercises as soon as possible Aspirate hemarthrosis if necessary
Ankle	Rarely encountered without fracture Reduce by traction and manipulation under general anesthesia Apply unpadded plaster boot Elevate foot on pillow for 1 or 2 days to prevent edema *Change plaster when loose* Permit weight bearing after 1 or 2 weeks Immobilize for 10 to 12 weeks
Tarsus	May be subtalar midtarsal or tarso-metatarsal Rarely encountered without fracture Reduce by traction and manipulation Immobilize in walking plaster for 10 to 12 weeks
Toes	Treat same as dislocations of fingers (p 29)

when the shaft of the metacarpal is driven through the joint capsule between the flexor tendons These close tightly around the neck of the metacarpal and are interposed between the articular surfaces Simple traction *merely clamps the tendon more tightly around the neck*

To effect reduction a piece of gauze bandage is looped around the phalanx Traction is made in the direction of hyperextension and the base of the phalanx is pushed distalwards to the metacarpal head before the phalanx is flexed This maneuver may require general anesthesia If this procedure fails an *open reduction* is required

After reduction of dislocations of the fingers *immobilization* in moderate flexion is indicated This is continued for two weeks The other fingers are actively exercised throughout the period of immobilization Buttonhole dislocations also occur in the other interphalangeal joints

DISLOCATIONS OF THE HIP

The incidence of dislocations of the hip has increased markedly with increase in automobile accidents The usual history is one of having been thrown forward, striking the knee against the dashboard The force transmitted along the flexed femur drives the head of the femur backwards over the posterior ring of the acetabulum On examination the thigh is flexed internally rotated and adducted The limb is shortened The head of the femur may be felt as a prominence in the buttock The *sciatic nerve* is

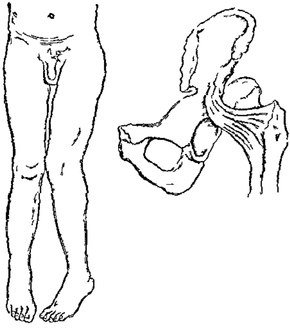


Fig 795 —Typical deformity and position of head of femur in posterior variety of dislocated hip *

sometimes compressed but neurologic symptoms generally disappear after reduction

Reduction requires general anesthesia With the patient lying upon his back the thigh is gently flexed with the knee at 90 degrees The pelvis is steadied by an assistant while the operator gently lifts the head of the femur over the acetabular lip back into the acetabulum *Acetabular lip fractures* (p 3005) if present generally accompany the head back into position The extremity is *immobilized* for one month in a *plaster spica* with the hip in neutral position and the knee slightly flexed Roentgenograms in two planes are necessary for postoperative check

Anterior dislocation of the hip is rare due to the greater strength of the anterior capsule The limb is held everted and abducted *Reduction* is

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accomplished by *manipulation* under general anesthesia After the thigh has been flexed pressure is made over *the abductor regions* so as to *push* the femur laterally and allow the head to enter the socket *Immobilization* is carried out as in posterior dislocation.

Complications —The cardinal complication of dislocation of the hip is *aseptic necrosis* (p 3043) *of the head of the femur due* to interruption of its blood supply by tearing of the round ligament and capsule This does not become apparent until several months after the injury when density on radiography and later collapse of part or all of the head may be visible This may occur in from 20 to 30 per cent of cases Its occurrence cannot be prevented or foretold The fate of the head is sealed at the time of injury and the patient must be warned of this possibility

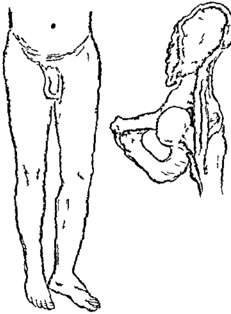


Fig 96 —Typical deformity and position of head of femur in anterior variety of dislocated hip

Occasionally though no gross aseptic necrosis has occurred the injured hip is after several years the seat of a premature and unilateral *osteo arthrosis* (p 2855) This must be considered a result of damage to the joint cartilage and of microscopic avascular necrosis not determinable by earlier radiographic examination

Dislocations of the femur *into the pelvis* are considered with *central fractures of the acetabulum* (p 3005)

DISLOCATIONS OF THE KNEE

Dislocations of the knee are severe injuries often accompanied *by fractures of the tibial spines* (p 3040) which are avulsed by the cruciate ligaments Because of the absence of thick covering musculature the diag

nosis is apparent on inspection There may be accompanying nerve and vascular injury *Compound dislocation* may occur

The *treatment* is by manipulative reduction under general anesthesia Because of the extensive ligamentous damage the knee slips back quite easily with traction and manipulation An occasional case may be encountered in which closed reduction is not possible At open reduction the cause of failure is found to be capsular or tendinous interposition Rarely a torn semilunar cartilage (p 2960) may become interposed and prevent reduction

Immobilization in a long leg plaster should be continued for three months Weight bearing is permitted after five or six weeks *Aspiration of the hemarthrosis* in the first week may aid in preventing subsequent adhesions

Throughout the period of immobilization active *quadriceps tightening exercises* are practiced This is especially important in this region because the integrity of the knee joint is largely dependent upon a strong and active quadriceps Indeed if the quadriceps is well developed the patient

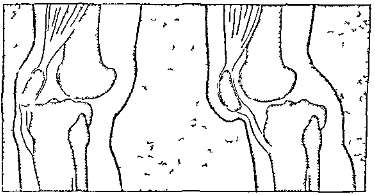


Fig 797—Anterior and posterior dislocation of knee *

may have a symptomless knee despite a surprising degree of ligamentous instability In the occasional case of continued symptoms of instability despite adequate quadriceps function a reconstructive repair of the ligament may be indicated

DISLOCATIONS OF THE PATELLA

Acute dislocations of the patella occur as a result of a direct injury which generally displaces the patella over the lateral femoral condyle The diagnosis is so easy that the patient often makes it himself and reduces it correctly by the simple method of manual reposition The injury is accompanied by tearing of the capsule on the medial side of the patella with resultant hemarthrosis

Treatment is accomplished by *reduction* using manual pressure with the knee fully extended The knee is *immobilized* in a walking *plaster* (p 2997) for four weeks following reduction *Quadriceps exercises* are started as soon as acute pain subsides *Aspiration of the hemarthrosis* in the first week relieves distention and pain

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Habitual or recurrent dislocation of the patella may follow improperly treated acute dislocation. It is generally associated with a flattening of the outer femoral condyle, knock knees or an elongated patellar ligament. *Treatment is operative.* The best procedure is *excision of the patellar ligament insertion* and its replacement further distally and medialwards on the tibia.

DISLOCATIONS OF THE ANKLE

Because the ligaments which bind the ankle joint together are generally stronger than the malleoli themselves, complete dislocation of the ankle without fracture is extremely rare. However, *posterior, anterior* and *upward dislocations* have been described. In the e the astragalus is pushed upwards between the separated tibia and fibula. Compound dislocations may occur.

Reduction is accomplished under general anesthesia by *traction* and *manipulation*. An unpadded *plaster boot* (p. 2996) is applied by an assistant while the operator maintains the reduction. The foot is elevated on a pillow for a day or two to prevent edema. The plaster is changed as soon as it becomes loose. Weight bearing is permitted *after a week or two*, provided the plaster still fits snugly. Immobilization is continued *for ten to twelve weeks*.

DISLOCATIONS OF THE TARSUS

With *subtalar dislocations* the ankle mortise remains intact but the foot is displaced on the talus. Displacement may occur in inversion or eversion.

Reduction is accomplished by *traction* and appropriate *manipulation* under general anesthesia. *Immobilization* in a walking plaster should be continued for ten to twelve weeks.

Dislocations at the *midtarsal* and *tarsometatarsal* joints are rare and generally offer no difficulty. *Immobilization* in a well fitting *plaster boot* (p. 2996) is continued for six weeks.

CHAPTER 138

TRAUMATIC DISTURBANCES OF THE SKELETAL AND LOCOMOTOR SYSTEMS THE GENERAL MANAGEMENT OF FRACTURES

THE fractured bone is one in which there has been an interruption in the continuity of the osseous structure Together with the break in bone endosteum and periosteum are torn, local blood vessels and lymphatics are ruptured, and the tissues become infiltrated and engorged with blood lymph and inflammatory exudate There is resultant swelling pain and circulatory disturbance of greater or lesser degree These last are increased by handling of the extremity and movement of bone fragments

Incidence of Fractures—There has been a recent increase in the incidence of fractures due to greater number of traffic accidents the increased popularity of contact games and the complexity and speed of operations in industry As a result the general practitioner is called upon with great frequency to deal with the problem of broken bones Satisfactorily to function in his community he must be equipped to give first aid or emergency treatment but unless the circumstances are extreme he must avoid the error of over reaching and attempting to deal with injuries that are specialist problems The present material obviously not a complete treatise of the management of the fracture aims to guide the practitioner in first aid or emergency treatment and the management of the simpler fractures It includes directions for the urgent management of such an exigency as the broken neck with symptoms of cord compression but it does not presume to instruct in the technics which require unusual skill training and apparatus

THE CLASSIFICATION OF FRACTURES

Fractures are classified according to predisposing factors morphologic manifestations and mechanisms

The Predisposing Factors—Local tissue changes predispose to the occurrence of fracture These include

1 *Atrophy* which is a potent factor in the hip fractures of the senile
2 *Disturbances of bone metabolism* particularly cystic disease that accompanies hyperparathyroidism (p 1225)
3 *Neoplasm of bone* such as primary sarcomas (p 2843) secondary carcinomas (p 2848) or multiple myelomas (p 1126)
4 *Neurogenic factors* such as tabes (p 1464) and hemiplegia (p 1439)
5 *Inflammation* as in tuberculosis of bone (p 2942) typhoid abscess of bone and chronic osteomyelitis (p 2930) with sequestration

In the presence of any of these predisposing factors relatively *inconsequential trauma* may produce fracture of the comprised bony structure In point of fact the fracture may be *spontaneous* *i e* result during the

course of normal bodily activities (fracture of rib during sneezing cough ing or forced inspiration) The spontaneous fracture is also termed a *pathologic fracture* (p 2840)

Morphologic Types—The fracture assumes protean *morphologic mani festations* It may be *closed* or *simple* meaning that the overlying skin is intact *Compound* fractures are associated with a break in the overlying skin Fractures are *incomplete* when the fragments remain in continuity They are *complete* when they are entirely separated

Relative to a joint the fracture may be *articular juxta-articular* or *intracapsular* Fracture lines are *linear spiral comminuted fissured im pacted stellate double multiple oblique transverse splintered* or *longi tudinal*

The fracture may be *complicated* by soft tissue injury such as an ex tensive hematoma injury to the local nerves or blood vessels or to under lying structures such as the brain the cord the pleura the lungs the blad der and so on

In children the fracture near the articular end may be epiphyseal and those of the shaft may be greenstick and incomplete

Fracture Mechanism—Commonly the cause of the fracture is *direct trauma* However the violence may be *indirect* resulting from transmitted force or muscle pull or a *contrecoup* as in skull fractures

The *mechanism* may be that of bending bursting or torsion It may be one of compression as in spine injuries following falls in which the patient lands on the head or the buttocks

Special Types Frequently Encountered—The character of the fracture may be determined by the type of injury Thus in automobile accidents the *chauffeur s fracture* involves the radius (p 3023) or carpus (p 3033) due to a sudden and violent reversing of the starting crank A *bumper fracture* is a comminuted compression fracture of the outer tuberosity of the tibia (p 3046) or may involve both legs immediately below the knee (p 3047) A *cartwheel fracture* is a separation of the lower femoral epiphyses (p 3045) as the result of the leg slipping between the spokes of the revolving wheel

In the aviation industry the *propeller fracture* involves the humerus The *clay shoveler s fracture* is a tear of one or more spinous processes of the lower cervical or upper thoracic vertebrae (p 3004) It occurs when the clay unexpectedly sticks to the shovel at the end of the shoveler s swing

In military medicine the *grenade thrower's fracture* is a break of the humerus (p 3019) caused by muscular contraction resulting from hurling the grenade A *march fracture* is a break usually of the second or third metatarsal (p 3053) without any significant history of a single trauma

A *gutter fracture* is the familiar skull fracture (p 1450) of the alcoholic An elliptical depression occurs where the head strikes the pavement In sports a *sprinter s fracture* results from an avulsion of the anterior supe rior or anterior inferior spine of the ilium at the start of the spring A *boxer s fracture* involves the distal extremity of the second to fifth or the base of the first metacarpal (p 3034)

Fracture dislocations occur near the joint They involve dislocations or subluxations of the articular surfaces and a break in the continuity of the contiguous bone

TABLE 156

THE MANAGEMENT OF THE PATIENT WITH FRACTURE

DO	DON'T
Handle gently	Don't make an unnecessary examination
Remove clothing by cutting along seams	Don't increase the injury by rough handling
Cover with blankets or keep warm with outer clothing	Don't permit the patient to attempt weight bearing to see if he can walk
If pain is severe or there is an appearance of shock, give an immediate hypodermic of dilaudid 2 mg. (1/[illegible] grain), demerol 50 mg. ([illegible]/8 grain) or morphine sulfate 15 mg. ([illegible] grain)	*Don't attempt to elicit crepitus*
If fracture is compounded or there are any open wounds, give an intramuscular injection of 100,000 units of penicillin	Don't save the clothes and compound the fracture
Attempt to elicit a history of allergy by inquiring concerning hay fever, asthma, urticaria, previous serum injection or immunization	Don't give a slug of whisky or an injection of caffeine, strychnine, coramine, metrazol or *camphor for alleged stimulation*
If there is an open wound and particularly with a compounded fracture, perform skin or ophthalmic tests for sensitivity to horse serum. If negative, inject 1 cc. of tetanus gas gangrene antitoxin N.N.R. If the patient has previously been immunized to tetanus and there seems no danger of gas gangrene contamination, inject 0.5 to 1.0 cc. of alum precipitated tetanus toxoid	Don't give an injection of epinephrine unless there is clear cut indication
If sensitization is probable, prepare to give intracutaneous antitoxin in graded doses at intervals of 30 minutes. Begin with 0.1 cc. and utilize increments of 0.2 cc. unless there is untoward reaction	Don't over reach and attempt to perform any reduction procedure that is beyond your experience and technical ability
Under any circumstance have available 1 cc. of 1:1000 epinephrine for use in case of anaphylactic reaction	Don't be too proud to summon the specialist surgeon or orthopedist
Heed the principle of "splint them where they lie"	Unless in the golden period of the *first 20 minutes don't attempt* reduction without anesthesia
For temporary immobilization keep available a litter, an arm splint and a leg splint (Figs. 803, 804, 805, 806.)	Don't add insult to injury of a wound by bathing it in antiseptic solution, particularly 7 per cent tincture of iodine
If the fracture is not compounded, the patient is not in shock and displacement is not excessive, attempt reduction in the golden 5 to 20 minutes that elapse following the injury. During this period there is no significant swelling, and the numbness and paralysis following the trauma permit easy and painless reduction	*Don't delay eventual healing* by dusting sulfanilamide powder into the wound. Place reliance on sterile saline solution and instillations of penicillin (1 cc. = 1,000 units)
Closed reduction may be attempted by manual traction along the long axis or by manipulation. In the latter, the fragments are disengaged by traction and then restored to their normal alignment by counter pressure over the site of the break	Don't bandage or splint an extremity with such vigor that the pulse is obliterated, the hand becomes ashen or cyanosed or the patient complains of paresthesia
Under any circumstance the patient must be transported carefully and gently. The injured member is grasped firmly and pulled in the long axis of an extremity if no splintage is available	Don't wait for the swelling to subside before making preparations for reduction
	Don't fail to get expert opinion if reduction cannot be accomplished and maintained

TABLE 16 (*Continued*)

THE MANAGEMENT OF THE PATIENT WITH FRACTURE

DO	DON'T
If splintage is available pull gently and steadily in the axis of the injured extremity. Lift it slowly from the ground and slip the half ring of the splint under the arm or leg from the outer side. Place the side bars so that the ring rests over the shoulder or against the tuber ischii. Buckles are strapped and ankles or wrists are protected with cotton wadding. A traction hitch is applied about ankle or wrist and tied to the end of the splint. Traction is increased by a Spanish windlass action using tongue depressors. When this has been accomplished manual traction is released. The injured extremity is supported by bandage or a muslin hammock. Lateral movement is prevented during transportation.	Don't let the patient disappear after reduction and immobilization without a check-up film and a 24-hour observation of the dressing or cast.
On arrival in the office or hospital get immediate x-rays in two planes.	Don't immobilize too completely and too long or muscles will atrophy, bone decalcify and joints ankylose.
While the films are developing examine for associated injuries to the local vessels, nerves, tendons or joints. Lesions involving these structures do not visualize on roentgenograms.	Don't immobilize for too brief a period lest the fragments slip.
If the patient has sustained a head injury or is disoriented or comatose get an x-ray of the skull at the same time.	Following reduction if there is continued pain don't give repeated doses of opiate but conclude that there must be some local disturbance which may be detected by the specialist.
If there has been an injury in the region of the thorax get a chest film.	Don't fail to continue the systemic injections of penicillin following reduction. If parenteral administration cannot be accomplished and oral or rectal preparations are not available switch to sulfadiazine giving 1 gm (15 grains) every 4 hours with 4 gm (60 grains) of bicarbonate of soda and a full glass of fluid. Make arrangements for urine and blood testing at 24- and 72-hour intervals.
If the lesion involves the lower lumbar region examine the urine for blood macroscopically and microscopically.	Don't fail to make a complete written record of your observations and treatment against future use in Court in the event of litigation.
With an extremity injury film the uninjured member for comparison.	Don't treat the fracture and neglect the patient who may have sustained other injuries or who may have been injured for the very reason that he suffers from some systemic disorder (generalized arteriosclerosis, hyperthyroidism, hyperparathyroidism, epilepsy, alcoholism, cerebrospinal syphilis, diabetes mellitus or hypoglycemia from overdosage with insulin).
Look for disturbances elsewhere since multiple fractures are encountered not infrequently.	Don't bother about the fracture if patient has a head injury
If it is at all possible summon a specialist if the fracture involves maxilla, mandible, spine, femur or both bones of the leg or forearm; if the fracture is comminuted, irreducible or compounded; if the patient is old, debilitated or so young that epiphyseal development has not been completed; if there is associated injury to nerves, blood vessels or joints; if there seems indication for open reduction or traction.	
If a specialist is not available and the fracture is simple and apparently reducible by traction or manipulation induce local anesthesia by injection of procaine or employ general anesthesia by the intravenous injection of sodium pentothal (p 3923) or inhalation of nitrous oxide, ether or chloroform.	

TABLE 156

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If sensitization is probable prepare to give intracutaneous antitoxin in graded doses at intervals of 30 minutes Begin with 0 1 cc and utilize increments of 0 2 cc unless there is untoward reaction	Don't overreach and attempt to perform any reduction procedure that is beyond your experience and technical ability
Under any circumstance have available 1 cc of 1 1000 epinephrine for use in case of anaphylactic reaction	Don't be too proud to summon *the specialist surgeon or orthopedist*
Heed the principle of "splint them where they lie"	Unless in the golden period of the first 20 minutes don't attempt reduction without anesthesia
For temporary immobilization keep available a litter an arm splint and a leg splint (Figs 803 804 805 806)	Don't add insult to injury of a wound by bathing it in antiseptic solution particularly 7 per cent tincture of iodine
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Closed reduction may be attempted by manual traction along the long axis or by manipulation In the latter the fragments are disengaged by traction and then restored to their normal alignment by counter pressure over the site of the break	Don't bandage or splint an extremity with such vigor that the pulse is obliterated the hand becomes ashen or cyanosed or the patient *complains* of paresthesia
Under any circumstance the patient must be transported carefully and gently The injured member is grasped firmly and pulled in the long axis of an extremity if no splintage is available	Don't wait for the swelling to subside before making preparations for reduction
	Don't fail to get expert opinion if reduction cannot be accomplished and maintained

sinus formation sequestration or loss of limb by amputation Malunion may disturb the mechanics of adjacent joints altering the line of weight bearing or producing deformity of joint surfaces After a period of time the effects become evident in severe *osteo-arthritis*

Systemic Effects.—The immediate systemic effects of the injury may dominate the clinical picture to the extent that the practitioner s first duty is the care of his patient rather than the repair of the bony lesion There may be profound shock that precludes any local manipulation to the bone

A compound fracture soiled with contaminated material requires a prophylactic injection of *tetanus* and *antigas antitoxin* (p 301) This should be preceded by skin testing (p 558) and if necessary desensitization (p 563)

Prolonged immobilization in the elderly and debilitated patient carries the threat of a hypostatic pneumonia (p 2189) with its significant mortal ity The continued pain and discomfort the necessary administration of

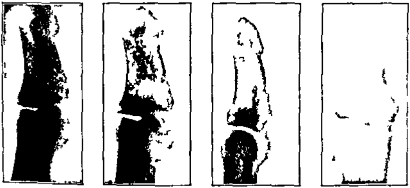


Fig. 98 June 17 1931 | Fig 799 August 4 1931 | Fig 800 September 17 1931 | Fig 801 October 16 1931

Figs 98 to 801 —*Roentgenograms showing the progressive healing of the fracture as it fills in with new bone from within outward* There was complete healing at six months (Smith and Rider)

repeated and large doses of analgesics and narcotics produce *demoraliza tion exhaustion states* and *psychoses*—each of which may terminate fatally Alcoholics may be precipitated into a *delirium tremens* (p 1384)

MECHANISM OF HEALING OF FRACTURES

The breaking of living bone is accompanied by *hemorrhage* The bleed ing comes from marrow spaces stripped periosteum vessels of soft tissues and capillaries of bone itself As a result the fragments of bone are bathed in blood A *saccular hematoma* is formed which can be utilized for the production of local anesthesia (p 3916) *preliminary* to the reduction of the fracture

The extravasated blood surrounding the fragments lays down fibrin Vascular granulation tissue begins to invade the hematoma The clot passes through a fibrinous and then a fibrous stage until it has been com pletely organized

The Callus.—After a week or two irregular *bony lamellae* invade the

TABLE 106 (*Continued*)

THE MANAGEMENT OF THE PATIENT WITH FRACTURE

DO	DON'T
Under anesthesia, attempt reduction by manual traction along the long axis of the extremity or by manipulation in which the fragment is disengaged by traction and restored to normal alignment with the aid of counter pressure at the site of the injury Following reduction maintain alignment by position and splintage immobilizing the joint above and the joint below the site of the fracture In the application of the dressing allow for the swelling that will ensue in the next 8 to 12 hours Check the accuracy of reduction and immobilization by a repeat x ray taken in two planes Check for associated nerve and vessel injury again by feeling the peripheral pulse noting the color beyond the cast and the accuracy of gross superficial sensation Arrange to see the patient at the end of 12 or 24 hours to check once again on the accuracy of reduction and the integrity of the local blood vessels and nerves Encourage active motion of the non immobilized parts as soon as is possible When callus formation is satisfactory and the union seems reasonably firm prepare to change the cast so that massage and passive motion can be instituted	Don't ignore persistence of swelling beyond 12 hours or undue swelling These may indicate serious hemorrhage with probable vascular complications such as ischemic paralysis In the presence of associated hemarthrosis don't treat the continued pain by repeated injections of the opiate but practice aspiration of the cavity Don't fail to realize that healing occurs with difficulty in the subcapital and intracapsular regions of the femoral neck the junction of lower and middle thirds of the tibias the proximal third of the carpal scaphoid, the lower third of the ulna and the junction of the lower middle thirds of the humerus These areas require more prolonged immobilization

THE SIGNIFICANCE OF FRACTURE

The fracture is a potentially serious injury It may result in local tissue damage beyond the bone injury or produce widespread systemic effects

Local Effects—The local effects of the fracture may relate to the *osseous tissue* or the adjacent structures With reference to the former the break may produce disability due to *delayed union or nonunion* (p 2988) *malunion* or *ankylosis* (p 2810) There may be persistent *pain* that requires the prolonged use of analgesics or even narcotics *Deformity* interferes with economic restitution or indulgence in recreational sports

Trauma sufficient to break bone imposes significant damage to *soft tissue and viscera* in the immediate vicinity Fracture of the skull or spine jeopardizes delicate *nervous tissue* Fracture of a rib may cause penetration or perforation of *lung* Fracture of the bones of an extremity produces hemorrhage threatening the integrity of adjacent muscles and tendons nerves and blood vessels The fracture line may penetrate the articulation adding to the gravity of the situation and the potential disability

Delayed local effects may be of such gravity as to cause the death of the patient *Contaminated fractures* serve as a portal of entry for systemic bacterial invasion *Acute* and *chronic osteomyelitis* (p 2930) result in protracted incapacitation delay in the healing of bone deformity chronic

graph With eburnation immobilization can no longer effect union The patient should be referred to the orthopedic surgeon At operation the eburnated ends are opened Union is effected by a bone graft if necessary

MEDICOLEGAL ASPECTS OF FRACTURES

Because of the permanency of bone roentgenograms and the persistence of cosmetic and functional impairment the fracture offers a rich field for medicolegal controversy Sooner or later each practitioner who treats any considerable number of fractures will have his day in court His greatest protection under these circumstances is a complete set of serial films and accurate clinical notes

The medicolegal concern may be relative to (*1*) the extent of the injury (*2*) its mechanism (particularly in compensation cases) (*3*) the correctness of procedure and (*4*) the evaluation of the end result (as in malpractice suits) The last is a particular nuisance in the litiginous malingerers and in the hysteric

Possible litigation demands accurate records With reference to the fracture data should be specific about the following points (*1*) The *mechanism* of the injury (*2*) The presence of *predisposing pathology* (*3*) The *relation of the injury to work* (in compensation cases) (*4*) The *time interval* between the production of trauma and the arrival of the physician (*5*) The type of treatment afforded *prior to the arrival of the practitioner* (*6*) The *general condition* of the patient particularly as to intoxication and/or *shock* (*7*) The *local neurologic examination* at the time of the first visit (*8*) The *details of treatment* (*9*) The *number of subsequent visits* the treatment employed and the directions to the patient

PHYSICAL EXAMINATION OF THE PATIENT WITH A FRACTURE

A complete physical examination of the patient with a fracture is required to disclose predisposing factors and to estimate the risk of anesthesia and operation Associated injuries occurring at the time of the fracture are to be particularly sought Certain fractures are frequently associated with accompanying injuries to adjacent bones or joints When one of the two parallel bones is fractured in the forearm and leg the other bone may be fractured further up or down the shaft Fractures of the ulna with overriding are frequently accompanied by displacement of the head of the radius Fractures of the tibia with overriding are frequently accompanied by fractures of the fibula at a different level

Local Examination—Where a fracture is accompanied by obvious deformity and displacement the diagnosis is at once apparent and there is no need to attempt to elicit the classical signs of crepitus and false motion Fractures without marked displacement and particularly fractures accompanied by a great deal of edema are not at once apparent to the examining eye The most reliable sign of fracture is disinclination to use the extremity and point tenderness over the bone at the site of the fracture In addition axial percussion or pressure causes pain referred to the fracture site A false point of motion and bony crepitus are pathognomonic of fracture To elicit them may however produce further damage to the traumatized structures in the area

young fibrous tissue They rapidly increase in number and extent until the bone ends are surrounded by a large expanded mass of cancellous bone (callus) The callus is clearly visible on the radiograph

Realignment —As healing proceeds *the callus is gradually realigned internally* under the stress of function until it conforms to the shape of the normal bone (Wolff s law) It possesses a *compact cortex* and a *marrow cavity*

Healing —The healing of fractures is greatly affected by the quality of the treatment *Reduction* is best effected in the early stages of the injury Reduction may be *closed* (by manipulation) or *open* (by surgical intervention) The reduced fracture is treated by *immobilization* assuring the approximation of the fragments until union has occurred Immobilization is continued until the bone ends are firmly healed by primary callus Immobilization may be effected by such procedures as splinting traction or the surgical use of plates nails and wires

The complete reconstruction of the normal structure may take a year or more The process is more rapid in the young and slower in the aged It is faster in small bones (such as the metacarpals) than in the larger bones (such as the femur) It is faster in cancellous than in compact bone Fractures near the bone ends heal more rapidly than fractures in the middle of the shaft

The healing of the fracture is dependent upon individual variations In growing bone normal muscular pull and function correct marked displacement and angulation Thus in children evidences of fracture may not be visible a few years later despite a comparatively poor reduction Adult bone is not so charitable to the surgeon

Bone healing is impaired when there are deficiencies of vitamin D vitamin C and calcium

DELAYED UNION AND NONUNION

Delayed union and nonunion of the fracture cause *persistence of motion* between the fragments Occasionally the failure of healing is the result of the interposition of soft tissue between the bone ends Most often the cause is *inadequate immobilization* Under these circumstances the callus does not fuse It is interrupted at the site of motion by transversely arranged noncalcified fibrous tissue and cartilage This is the stage of delayed union If the process continues the bone ends become closed off by eburnated tissue and nonunion is present

Treatment —The treatment of delayed union and nonunion is the province of the specialist So long as the bone ends have not become thoroughly eburnated union is merely delayed and adequate immobilization may still be effective This may be accomplished by a well fitting unpadded *plaster casing* (p 2992) extended far enough to immobilize the bone against both lateral and rotational stress To accomplish this in the extremities *the joint at either end of the fracture is included in the immobilization* *i e* with delayed union of a fracture of the shaft of the ulna the splint extends from the knuckles to the mid humerus It may be necessary to continue immobilization from six months to a year

Nonunion occurs when the bone ends have been closed off by compact bone (eburnated) This is evidenced by a radiopaque area in the radio

graph With eburnation immobilization can no longer effect union The patient should be referred to the orthopedic surgeon At operation, the eburnated ends are opened Union is effected by a bone graft if necessary

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Roentgenographic Demonstration of the Injury—The patient with a demonstrable or suggested bony fracture requires roentgenographic study Indeed in certain areas of the country treatment of fractures without roentgenographic control may in itself be grounds for malpractice litigation The technic of roentgenography of the various parts is found elsewhere (p 3740)

Induction of Anesthesia—Most fractures may be reduced under local anesthesia (p 3916) This procedure is perfectly safe and has the advantage that the patient is conscious and his cooperation may be enlisted In addition the anesthesia generally persists sufficiently long so that if the first check up examination is not satisfactory, the plaster may be removed and remanipulation performed before the reappearance of sensation

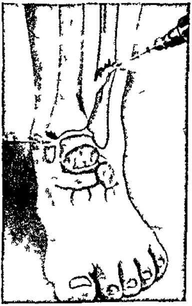


Fig 802—Pott s fracture Infiltration anesthesia with novocaine

Postreduction Roentgenography—Immediately following the reduction of every fracture the position of the fragments must be checked by roentgenographic examination through the plaster If the fragments are not in satisfactory position the plaster should be removed and reduction repeated Radiographs are repeated at frequent intervals particularly during the early period of immobilization to guard against the fracture slipping in the plaster Patients treated by traction should have frequent radiographic check ups

THE PRINCIPLES AND TECHNIC OF THE TREATMENT OF FRACTURES

There are two fundamental principles in the treatment of fractures

1 The fracture must be treated by satisfactory reduction and complete and continuous immobilization until union is sound

* Courtesy Winthrop Chemical Company

2 Joints in the vicinity of the fracture which need not be immobilized to effect sound union must be actively exercised from the first day of the injury Muscles and tendons are to be kept moving over immobilized joints in order to minimize periarticular ad hesions

Complete and continuous immobilization is best achieved by the use of the unpadded plaster splint (skin tight plaster) The temporary im mobilization of the fracture may be accomplished by a temporary remov able splint

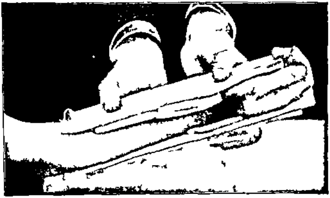


Fig 803 —Fracture of radius near wrist Method of applying anterior splint and pad and holding the two splints and arm for the application of straps Anterior splint is cut out below the thenar eminence

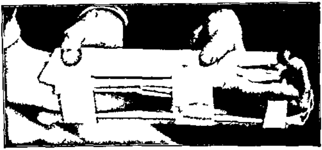


Fig 804 —Fracture of the forearm near the wrist joint Anterior and posterior splints Straps are taut Note length of splints the position of the three straps and the cutting out of the anterior splint to clear the thenar eminence

The Use of Removable Splints —Removable splints are applied in a variety of forms An ordinary *tongue blade* suffices to immobilize a finger fracture *Basswood splints* are conveniently used for undisplaced fractures involving the wrist hand or forearm A *removable splint* to fit almost any part may be molded out of ten or twelve layers of *plaster of paris Metal splints* are sold by the surgical supply companies These can be padded and bent to fit in the axilla over the elbow the fingers the wrist or the knee

The *Thomas splint* is best adapted for the first aid treatment of fractures of the lower or upper extremities This provides both immobilization and traction *Flannel or muslin* is wrapped around the double iron upright of the Thomas splint before it is ready for use The splint is applied *over the clothing* In fractures of the lower extremities the shoe should not be removed until the patient has arrived at the office or the hospital

In an emergency a temporary splint may be improvised from any firm *material* A piece of box a policeman s stick a ski pole branches from a tree and so on may temporarily fulfill this purpose

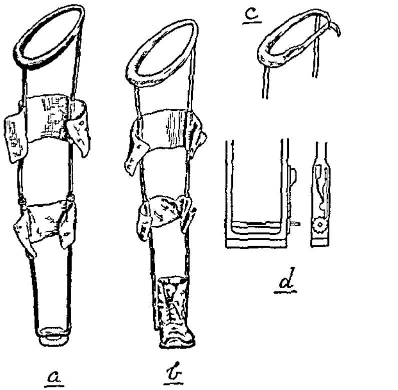


Fig 805 —Thomas knee splint for ambulatory treatment of leg fractures used with a light plaster of Paris leg splint. *a* Ordinary form *b* caliper" or convalescent splint so fitted as to keep the heel of the foot away from the boot while the toes are used *c* the half ring sometimes used at the upper end *d* lower end of splint as arranged for windlass traction *

The Technique of Applying Unpadded Plaster —Complete and continuous immobilization is best achieved by the use of the unpadded plaster splint The unpadded plaster splint consists of a *reverse of plaster* applied directly to the skin This is bound to the limb by *circular bandages of muslin or gauze* and an *outer casing of plaster of paris*

Use of Cut Lengths of Plaster (Specialist Plaster) —For the reverse the practitioner may conveniently use cut lengths of hard coated plaster of paris bandage as purchased from the manufacturer Casts made with these splints are strong yet light in weight They eliminate the unrolling

* Scudder The Treatment of Fractures.

and folding necessary with the rolled bandage From seven to nine layers are usually required for the preparation of one molded splint The exact number depends upon the thickness and strength of the cast required

Use of Plaster Rolls—If cut lengths are not available the unpadded cast is prepared from plaster of paris bandage The bandage is held in

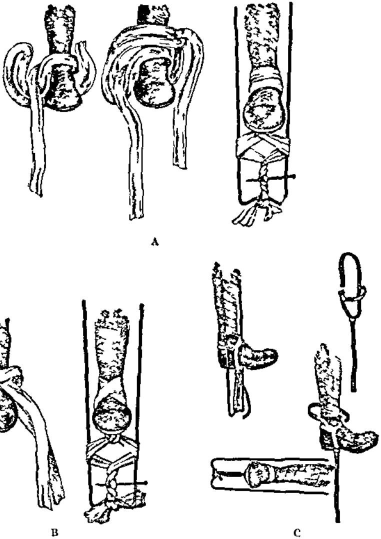


Fig 806—T action l tches for field transportation *A* Coll ns h tch *B* Poul quen hitch *C* Adjustable tract on strap and saddle gi th hitch (Blake)

the hands in a horizontal position and dipped in water for a few seconds until the bubbling stops It is then removed held with one hand at each end and squeezed so that the excess of water is expressed through the center of the length A reverse is laid by folding six thicknesses of 6 inch plaster for the necessary lengths (If hard coated plaster is used

the reverse can be folded dry and then dipped into the water) Wrinkles and irregularities in the reverse must be avoided

Triangular segments are cut out of the edges of the plaster at the site of joints in order to avoid irregularities Each succeeding layer of plaster



Fig 807—Posterior and anterior splints for elbow Anterior splint being applied *



Fig 808—Anterior and posterior splints for the elbow Note the additional plaster wedge being put in place to strengthen the anterior splint at the bend of the elbow *

is smoothed down against the underlying plaster so that the finished product is even and strong

* Scudder The Treatment of Fractures

The Plaster Gauntlet—A plaster gauntlet for the wrist extends from the knuckles to the elbow on the dorsum of the hand and forearm Whether or not lengths or bandages of plaster of paris are employed the molded product is applied directly to the skin

The dorsal unpadded plaster splint is held in place by lightly wrapping the extremity with 2 inch *gauze or muslin bandage* Finally the entire dressing is encased by a *circular bandage* of 4 inch plaster of paris applied without tension The fingers and toes are left free wherever possible

In the application of the unpadded splint several technical points deserve particular emphasis

1 The unpadded plaster reverse must be quite *wet* in order to mold closely to the contour of the limb



Fig 609—Fracture of the elbow or forearm Plaster of Paris splint being applied Elbow at a right angle

2 The muslin or gauze bandage and the outer circular plaster bandage *are applied without tension to avoid pressure on nerves and* vessels
3 Wrinkles and irregularities are smoothed out
4 The plaster of the gauntlet must not extend beyond the palmar crease but should reach to the knuckles on the dorsal aspect This permits free motion of the fingers and prevents edema of the back of the hand

Following application of the unpadded plaster splint to the upper extremity the arm is placed in a sling The patient is instructed to move the fingers under the practitioner's supervision He is urged to continue motion of the fingers at least once hourly during the first day At night the hand should be elevated on a pillow The patient is given a *hypnotic* to promote sleep in this awkward and unaccustomed position

Scudder The Treatment of Fractures

The patient is instructed to report any disturbance of the fingers Specifically he is told to note any blueness or pallor coldness, pain or impaired mobility

The patient is also told that the fingers will become swollen and that this must not prevent continuance of the motion It is not an indication for removal of the bandage but there must be a constant and repeated observation to spot any circulatory or neurologic disturbance

The part must be inspected at least once during the course of the first twenty four hours During the first weeks the patient is to be seen frequently Repeated radiographs are taken to assure maintenance of reduction

Any complaint of localized pain must be heeded If there is a single localized pressure spot particularly over a prominent bony part the plaster must be cut out and the underlying skin examined for pressure areas or sores

The Plaster Boot—The plaster boot is used to immobilize the foot ankle and lower part of the leg A posterior reverse (6 inch in adults) is applied from just below the knee to *beyond* the tips of the toes It is notched at the heel to conform to the ankle without wrinkles Circular wrappings of muslin or gauze bandage 3 inches in width are then applied The whole is surrounded by one or two rolls of 4 inch plaster bandage

While the reverse extends beyond the tips of the toes on the plantar surface to prevent toe drop the circular bandage is carried down just to the base of the toes on the dorsum of the foot leaving the phalanges exposed for observation of circulation and active motion

After the application of the unpadded plaster splint to the lower extremity the patient remains recumbent for one or two days with the foot elevated on a pillow During this time toe exercises are encouraged They are carried out every hour

The toes are watched for changes in color sensation or mobility in the manner described for the fingers If these do not shortly disappear the plaster is split down anteriorly from top to bottom through *all* thicknesses of material *down to the skin* If the constriction has not been present for any great length of time the circulation will promptly return

Long Leg Plasters—Long leg unpadded plasters are employed to immobilize the knee They may or may not include the foot If the foot is included they are applied precisely in the same manner as the plaster boot save that the posterior reverse is extended to a point just below the groin The knee is maintained in slight flexion

If the foot is not to be included there is a tendency for the cast to slip downward until it presses upon the malleoli This is prevented by applying two long strips of 2 inch adhesive plaster on either side of the extremity from the upper thigh to the ankle leaving about 6 or 8 inches below the ankle

The circular plaster is applied over these strips of adhesive leaving the lower 6 inches free After the first two turns of circular plaster have been applied the lowermost 6 inches of adhesive tape are turned up on either side and incorporated into the plaster This prevents the long plaster *from* slipping downward

The Walking Iron—In plasters which extend to the toes weight bearing may be permitted by attaching a walking iron after the plaster is hard This is usually done twenty four or more hours after the first application of the plaster The walking iron is bent to conform to the shape of the plaster At its lowermost portion it extends about 1½ inches below the heel The vertical iron should be parallel to the tibia The rubber cleat should be directly beneath the center of the heel Weight bearing is not permitted for twenty four hours after the incorporation of the iron

If the walking iron is to be used for any considerable period of time the shoe of the opposite foot should be raised by a corresponding amount so that both extremities are of equal length

Plaster of Paris Jacket—The plaster jacket effectively immobilizes the lower lumbar spine It is comparatively ineffective above the mid dorsal vertebra

A layer of stockinet is applied next to the skin Pads of felt are fixed by adhesive plaster over bony prominences and pressure points Several thicknesses of sheet wadding are wound around the torso Finally circular 6 inch plaster of paris bandages are snugly applied Vertical reverses should reinforce the jacket on both sides as well as anteriorly and posteriorly The jacket must be well molded over the iliac crest A small circular area may be cut over the abdomen to give the patient more comfort

Plaster Hip Spica—The hip spica requires an orthopedic table for proper application It is best left to the specialist

THE TECHNIC OF APPLYING PADDED PLASTER

Padded plaster casts are used occasionally in (*1*) *hanging casts* (*2*) *plaster jackets* where maximum immobilization is not needed or (*3*) in *postoperative* plaster immobilization

Circular plaster of paris bandages and reverses are applied after the extremity has been padded with circular wrappings of sheet wadding or felt Bony prominences especially must be well padded

THE APPLICATION OF TRACTION

Traction is a method of immobilization While the use of traction is usually limited to the care of the institutionalized patient under the supervision of the orthopedic specialist it may be improvised in the home by the practitioner

Moleskin adhesive plaster is the best material for the application of traction to the extremities Prior to the application of the moleskin the skin is protected by a preliminary painting of compound Tincture of Benzoin

The moleskin is applied as two long strips about 3 inches wide The strips extend from a point below or just below the knee on either side of the extremity to about 6 inches beyond the heel The free lower ends of the adhesive strips are attached to a wooden spreader bar wide enough to hold the moleskin away from the malleoli Traction weights are attached to this spreader by a rope

Circular or diagonal strips of ordinary adhesive should not be used to bind on the moleskin Elastic bandage is employed for this purpose

Traction requires constant watching Its ends are defeated if the patient is pulled downward against the lower part of the bed if the spreader rests against the lower upright of the bed or if the weights rest on the floor

The bandage is observed at frequent intervals to prevent the development of pressure sores The peroneal nerve is subcutaneous at the point where it winds around the fibular neck, and is particularly susceptible to pressure at this point Injury to the peroneal nerve may produce foot drop and anesthesia



Fig 810—Fracture of the elbow or forearm Application of sheet wadding for protection Method of holding the arm at a right angle *

THE OPEN REDUCTION OF FRACTURES

The open reduction of fractures is a specialist s procedure requiring the most meticulous operating room technic and great skill on the part of the operator

The open reduction of fractures is indicated (*1*) *when satisfactory apposition and immobilization cannot be effected by closed reduction* (*2*) in *malunion* and (*3*) in *nonunion*

THE TREATMENT OF THE FRACTURE AFTER REDUCTION

After satisfactory reduction of the fracture and the application of the plaster or splint the *joints not necessarily immobilized are freed* and put

* Scudder The Treatment of Fractures

through their active ranges of motion Thus with a wrist or low forearm lesion the fingers elbow and shoulder are actively exercised The patient is encouraged to use the fingers as much as possible in his daily routine

The active motion of the unsplinted joint has a beneficial effect on eventual motion of the splinted joint A wrist that has been immobilized for weeks during the treatment of a Colles fracture is stiff swollen and painful when the plaster is removed if the fingers have not been exercised However if the range of motion of the fingers has been utilized during the period of immobilization the wrist has an excellent range of motion upon the removal of the plaster



Fig 811 —Fracture of the elbow or f earm Appl cation of plaster-of paris bandage Method of holding the arm *

It is an important function of the practitioner to encourage measure and record the return of motion at regular intervals Uncooperative fear ful or hypersensitive patients must be compelled to go through daily exer cises under supervision

PROCEDURE FOLLOWING REMOVAL OF PLASTER

After the radiograph has shown healing of the fracture the plaster may be removed using a plaster knife or shears Immediately after its removal the skin is inspected for abrasions and pressure sores The align ment and cosmetic results are estimated and the fracture line is palpated If it is well healed there should be no tenderness

* Scudder The Treatment of Fractures

The patient is encouraged to put the joint *actively* through its range of motion This is to be repeated hourly during each day The extremity is used if possible in daily tasks It is immersed in warm water twice daily

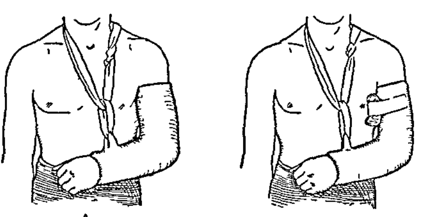


Fig 812—Hanging cast in fractured humerus *A* when no abduction is needed and *B* when abduction is needed A practical splintage for shaft fractures This maintains practically continuous traction via a heavy plaster casing *

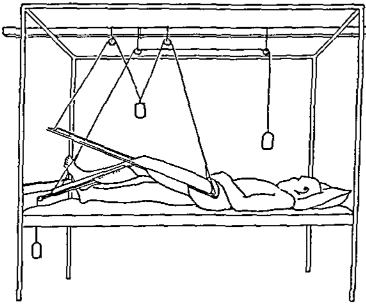


Fig 813—Skin leg traction following bumper fracture Note pulley attached to bottom of Pearson leg piece so that traction is maintained while the knee can still be flexed and extended through the counterbalancing weight lying in region of patient s hand This type of treatment is for the bumper fracture in which the compression is mild or in which following reduction and impaction it seems safe to allow motion while under traction †

for twenty minutes Under the influence of heat and the neutralization of gravity each joint is actively moved through its maximum range in every direction

* Moorhead, Clinical Traumatic Surgery

† Darrach, Murray and Marble Treatment of Fractures American College of Surgeons

Splints and part time immobilization are rarely necessary However when the elbow has been involved and full extension is limited a sling is used temporarily to take tension off the elbow flexors This is removed frequently during the day for exercise and is discarded by degrees

Support of the Lower Extremity—Lower extremity fractures require further consideration since vascular and muscle tone are rapidly lost in plaster and there is a tendency to subsequent edema On removal of the leg

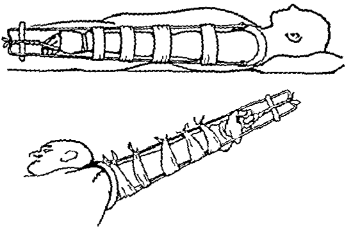


Fig. 814—Murray-Jones splint applied Note padding about wrist under traction loop *Spanish windlass traction with tongue depressor and hinging of splint to allow abduction for x ray purposes*

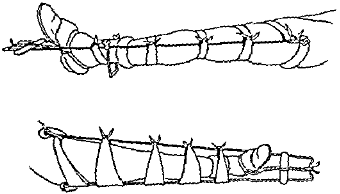


Fig 815—Keller Blake splint applied Note upper band to keep ring pulled up under ischial tuberosity and rest under lower end to keep heel off the bed or stretcher

plaster an elastic bandage or zinc gelatin paste boot is applied This may be gradually discarded after several weeks

The muscles which support the long arch lose tone after an interval of immobilization during which time weight bearing is not possible The patient with a lower extremity fracture must be instructed in exercises for the weak foot and in proper walk immediately upon removal of the plaster

Darrach Murray and Marble Treatment of Fractures American College of Surgeons

Shoe corrections or arch supports may be required temporarily Slippers should not be worn

PHYSIOTHERAPY

In the after treatment of fractures physiotherapy is used to mobilize stiff joints and strengthen atrophied muscles

The amount of physiotherapy required usually varies in inverse proportion to the adequacy of the primary treatment of the fracture Adherence to the principles previously described results in the preservation of maximal motion in the involved joint All that is then required is cooperation on the part of the patient to effect complete restitution of function Active motion is encouraged The patient is his own physiotherapist

Rarely the patient cannot perform active motion *passive exercise* is then initiated by the physiotherapist Passive motion must be gentle lest the tissues be torn and a *hematoma* result The latter produces scars that may lead to restriction of joint motion Passive motion is never used in the elbow

Other forms of physiotherapy consist of heat and light massage to increase the vascularity of the part to relax muscle spasm and to relieve pain These can be accomplished in the home by the use of hot water or radiant heat The use of more elaborate physiotherapy is not usually necessary

CHAPTER 139

TRAUMATIC DISTURBANCES OF THE SKELETAL AND LOCOMOTOR SYSTEMS THE MANAGEMENT OF SPECIFIC FRACTURES

FRACTURES OF THE SKULL

See p 1450

FRACTURES OF THE SPINE AND PELVIS

Fracture of the spine should be suspected until proved or disproved by radiograph in the unconscious accident victim and the conscious subject who complains of pain in the back numbness or paralysis of the extremities

The Mechanisms of Injury and the Types of the Spine Fractures—Each *vertebra* consists of a soft cancellous *body* and a relatively dense *posterior arch* which includes the *articular facets* Fractures occur through compression (flexion) or hyperextension

Injuries that tend to jackknife the spine into *flexion* result in a *compression* or crushing of the body leaving intact the denser posterior arch Thus a crushing force transmitted along the long axis of the spine (as a fall from a height when the patient lands on the feet buttocks or head) produces a crushing injury with compression of the body The stronger posterior arch remains relatively intact The site of the fracture is ordinarily at the level of the twelfth thoracic or first lumbar vertebra when the victim lands upon his feet or buttocks It is in the region of the sixth cervical when the compression is transmitted through the skull as in a dive into shallow water

A rarer mechanism of spine fracture is caused by extreme *hyperextension* In the hyperextension fracture the vertebral bodies are torn apart In a small percentage of cases the posterior arches of the vertebrae are fractured

TABLE 157—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF THE FACE AND JAWS SPINE PELVIS AND THORAX

Fractures of the face and jaws as well as of the spine and pelvis present problems for the specialist rather than for the practitioner Except for reduction of a simple nasal fracture and emergency treatment under other circumstances those who have not had particular specialized training in the management of these injuries should refer the patient to the indicated specialist.

Site	Clinical Manifestations and Treatment
Nasal Bones	Reduce by manual replacement Splints not required With compounding institute anti infective therapy (p 106)
Malar Bones	Usually depressed with considerable edema Refer to specialist for elevation of zygomatic arch by open reduction
Mandibles and Maxillae	Usually compounded into mouth Start anti infective therapy (p 106) Refer to dental surgeon for reduction and immobilization by wiring and other specialist methods Use fourtail bandage before and after reference to specialist.
Spinous Processes of Vertebrae	Usually avulsion fractures In cervical and upper dorsal regions If simple immobilization is ineffectual refer for operative removal of fragments
Transverse Processes of Lumbar Vertebrae	Usually due to indirect violence through muscle contraction Associated with *extensive soft tissue injury* Immobilize by adhesive strapping Operative removal if discomfort persists
Articular Facets of Vertebrae	Demonstrate by lateral oblique films If isolated try simple immobilization If pain persists particularly in lumbar region consider operative interference
Cervical Spine	Usually compression lesion of bodies of 6th and th vertebrae Result of fall on head or impact of head against roof of overturned car If suspected avoid examination and transport patient, in prone position with support to head Refer to hospital for specialist treatment. With urgent symptoms, attempt reduction by hyperextension and immobilize in plaster extending from iliac crest to top of head (p 3009) Maintain immobilization for three months and then recommend spinal brace Check with x rays Make frequent neurologic examinations with particular reference to disturbances of bladder rectum and lower extremities
Atlas and Axis	Usually due to hyper-extension from blow on point of chin High mortality through pressure on upper cervical cord Transport, in prone position with support to head Insist on specialist consultation
Dorsal and Lumbar Spines	Usually from crushing injury due to fall on feet or buttocks Compression fractures reduced by hyperextension of trunk Immobilize in hyperextended position by plaster cast from manubrium sterni to symphysis pubis Maintain for three months and replace by spinal brace Check carefully for evidences of cord injury with particular reference to bladder rectum and lower extremities

TABLE 157—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF THE FACE AND JAWS SPINE, PELVIS AND THORAX (Continued)

Site	Clinical Manifestations and Treatment
Pelvis	Usually from direct violence in fall or automobile injury Insist on hospitalization for x ray survey and examinations of urethra, bladder and rectum With significant soft tissue damage or displacement, reduce and immobilize in plaster spica Injuries to orifices call for intensive anti infective treatment injections of tetanus-gas-gangrene antiserum and operation if there is extravasation of urine or rupture of bladder
Sacrum and Coccyx	Unless displaced require only immobilization If fragment of coccyx is loose suggest operative removal
Sternum	Reduce by hyperextension Immobilize with plaster
Ribs	Get chest x ray for evidences of intrathoracic injury particularly pneumothorax penetration of lung or hemothorax Reduce under procaine anesthesia if necessary Immobilize with plaster

First Aid Management and Transportation of the Suspected Spine Fracture—The practitioner who is summoned to the site of an accident must often deal with the immediate examination treatment and transportation of the patient with a fractured spine *An exhaustive examination* or an *injudicious attempt to effect a reduction* without considered knowledge of the morphology of the trauma may lead to tragic eventualities

To prevent further trauma the patient is gently rolled onto a stretcher and transported in the prone position The spine is kept as straight and rigid as possible Hyperextension and flexion are avoided The head is not supported by a pillow While in transit the stretcher is placed on a moderately firm surface *which does not sag* *The head of the unconscious patient* is supported and prevented from rocking from side to side

Extensive examination and/or attempted reduction of the fracture are postponed until radiographic examination has been performed in a well equipped institution The services of an orthopedist should be secured as soon as possible

Fractures of the Cervical Spine—The most frequent fracture of the cervical spine is a *compression lesion* of the body of the sixth or seventh cervical This is usually produced by a fall upon the head such as diving into shallow water or striking the head against the roof of an overturned car

The attention of the practitioner is drawn to these regions by the presence of *pain muscle spasm* and *marked limitation of motion* in the cervical spine Tenderness may be elicited over a localized area in the region of spinous processes of sixth or seventh cervical With extensive fractures associated with displacement there are usually evidences of *trauma to the cord* There may be *radiating pain* along the distribution of the lower cervical roots In the severer instances *paralyses* are present

X rays reveal a compression of one or more of the lower cervical ver

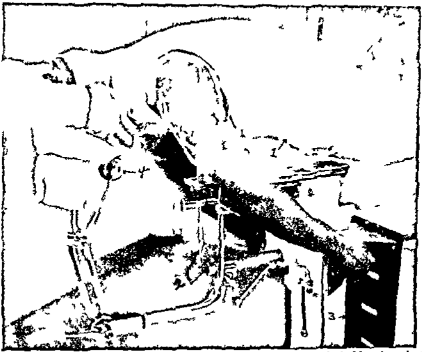


Fig 816—Application of Minerva jacket, 1 Canvas hammock hidden by plaster — adjustable rack is elevated 3 table leaves lowered 4 head rest dropped canvas hammock is withdrawn after plaster hardens



Fig 817—Apparatus for treatment of unilateral cervical dislocation Walton method of manipulation in process *

Manual of Orthopedic Subjects, National Research Council.

tebrae. There may be in addition fractures or dislocations of the posterior arches. The gravity of this type of fracture of the cervical spine demands the services of a specialist orthopedist and or a neurologic surgeon

In the event that the specialist cannot be summoned the practitioner may attempt reduction by *hyperextension* of the cervical spine particularly if the arches are intact. After reduction the neck is *immobilized* in a plaster cast extending from the iliac crest to the top of the head Immobilization is continued for a minimal period of three months, following which a spinal brace is indicated

With associated injury of the posterior arches hyperextension is not sufficient to maintain the reduction and the fracture must be treated by

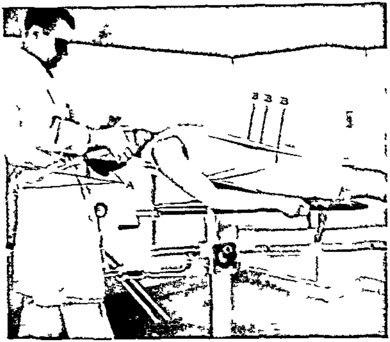


Fig. 518.—Method of applying straight-line pull for bilateral cervical dislocation *A* Halter purchase on occiput and chin, noose band extending around buttocks of surgeon, *B* countertraction bands from shoulders to perineal post, surgeon's foot abuts against stationary object on floor for better purchase.

traction and frequently by internal fixation These are institutional procedures executed under the supervision of the specialist.

Fractures of the Atlas and Axis.—Fractures of the atlas and axis are usually caused by *hyperextension* such as a blow on the point of the chin

Flexion fractures occur as the result of a blow on the back of the head driving the skull forward The flexion fracture carries forward the fractured *odontoid process* and the *atlas* to which it is bound by strong connective ligaments Direct downward blows upon the head may also produce fractures of the *lateral masses* of the atlas

* Manual of Orthopedic Subjects, National Research Council

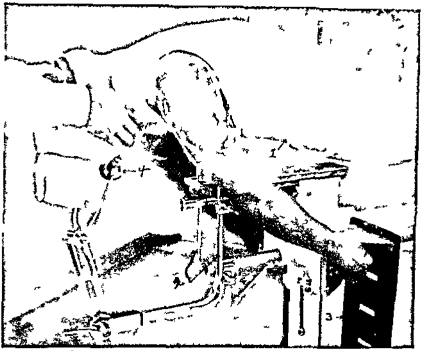


Fig 816—Application of Minerva jacket, *1* Canvas hammock hidden by plaster, 2 adjustable rack is elevated, *3* table leaves lowered *4* head rest dropped canvas hammock is withdrawn after plaster hardens



Fig 817—Apparatus for treatment of unilateral cervical dislocation Walton method of manipulation in process

Manual of Orthopedic Subjects, National Research Council.

Fractures of the Dorsal and Lumbar Spine —Fractures of the dorsal and lumbar spine usually occur from a crushing injury such as a fall on the feet or buttocks

The *flexion or compression fracture* unaccompanied by injury to the posterior arch may be reduced by hyperextension of the trunk To accomplish this the trunk is permitted to sag between two points of support—one at the arms and head the other at mid thigh By this procedure tension is made upon the strong anterior longitudinal ligaments correcting the compression of the vertebrae This procedure may be carried out with no more than morphine sedation

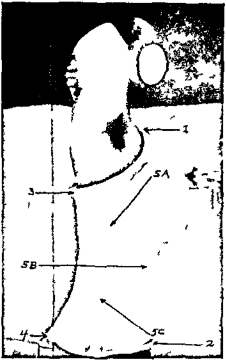


Fig 891 —Typical hyperextension ambulatory jacket *1* Top level of sternal notch *2* bottom at level of pubic crest *3* posterior top level clears lower angle of scapula *4* posterior bottom level with pubic crest *5* A B C three point pressure hold guarantees maintenance of hyperextension

The trunk is immobilized from the manubrium sterni to the symphysis pubis in a well fitting plaster jacket The jacket is worn for a minimum period of three months following which a spinal brace is employed until exercises have sufficiently rehabilitated the spinal muscles

The method of hyperextension cannot be used when there is injury to the posterior arches or an accompanying dislocation of the spine The problem of managing this type of injury as well as the hyperextension fracture is the province of the specialist

Fractures of the Spinous Processes —Fractures of the spinous processes

Fractures of the atlas and axis are accompanied by a *high mortality* through the vulnerability of the upper cervical cord Their treatment is

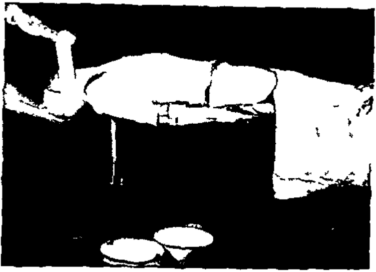


Fig 819 —Plaster application for immobilization of cervical injury *



Fig 820 —The jacket cuirass for high cervical fracture-dislocation The forehead and parietal regions are included sharply to limit rotation and nodding of head which takes place chiefly in the occipito-atlas, atlanto-axis articulations (*Lateral view*)

distinctly the province of the specialist Wherever possible he should be summoned

* Scudder The Treatment of Fractures

Fractures of the Pelvis—Fractures of the pelvic ring are generally produced by *direct violence* such as a fall or an automobile injury These fractures of the pelvic ring are rarely isolated and are usually multiple Thus a severe force transmitted through the neck of the femur may drive the head of this bone into the pelvis fracturing the acetabulum Lateral or anteroposterior compression causes fractures which extend through the margin of the obturator foramen An anterior fracture is almost always associated with a posterior break near the sacro iliac joint With suspected injury to the pelvic ring pressure is made laterally over the iliac crest

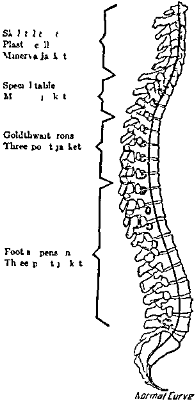


Fig 893—The different methods of treatment used for simple uncomplicated crush fr t e lepe d ng on the section of spinal column in ol ed*

and anteroposteriorly over the symphysis pubis and coccyx If pain is elicited by these maneuvers or there is direct tenderness anywhere along the ring a fracture should be suspected

Of greater importance than the bony injury is the trauma inflicted upon the adjacent soft parts particularly the *urethra* and *bladder* A urine analysis must be obtained Gross bleeding suggests associated injury to the urinary passages If the patient is unable to pass a specimen possible *rupture of the bladder* is suspected Gentle catheterization under meticulously aseptic conditions should be performed

* Deaver Surgical Anatomy of the Human Body The Blakiston Company

occur most frequently in the cervical and upper dorsal regions They are usually *avulsion fractures* resulting from muscular violence

The fractures of the seventh cervical and first dorsal vertebrae are often known as "clay shoveler's" fracture The injury occurs during the act of shoveling particularly when a sticky substance like clay unexpectedly adheres to the shovel

Treatment may necessitate operative removal of the fragment Some patients recover completely with conservative (immobilization) therapy despite nonunion of the fragment

Fractures of the Lumbar Transverse Processes—The lumbar transverse processes are usually fractured as the result of indirect or muscular violence by contraction of the psoas or quadratus lumborum In consequence the bony fracture is accompanied by extensive soft tissue injury

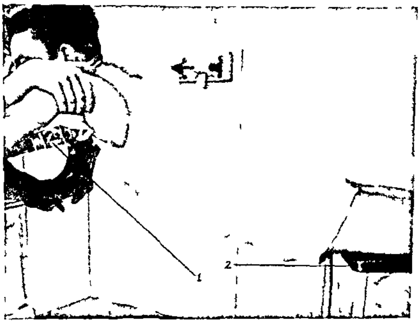


Fig 802—Watson-Jones technic for reduction of uncomplicated crush fractures 1 Typical operating table being elevated the required amount, 2 stationary table

If the lesion involves a single process and there is minimal displacement adequate treatment may be accomplished by adhesive strapping or by the type of leather belt used by motorcyclists

More severe injuries require a longer period of immobilization using fracture boards or a plaster jacket

Fractures of Articular Facets.—Fractures of articular facets may accompany other injuries of the spine or they may be isolated lesions Special radiographic technics are required to demonstrate them They are distinguished from congenital failure of fusion of part of the facet by the jaggedness of the fracture line

If symptoms persist after adequate conservative therapy operative intervention may be necessary

* Manual of Orthopedic Subjects, National Research Council

FRACTURES OF THE FACE AND JAWS

Fractures of the face and jaws are usually the result of direct injury They often result from traffic accidents and are frequently associated with skull fractures and severe injury in other areas To insure an optimal functional result relative to mastication respiration and for cosmetic reasons it is advisable to consult with the *dental surgeon* the *rhinologist* and the *plastic surgeon* if possible

Fracture of the Nasal Bones—Fractures of the nasal bones are due to *direct violence* The fracture is usually *comminuted* Swelling is so marked and so rapid that it may conceal the bony deformity If the latter is not corrected there may be serious interference with the airway obstruction to sinus drainage and more than a little discomfort and disturbance

Reduction is often accomplished by manual replacement Splinting does little or no good although some type of dressing is usually applied for the patient s peace of mind

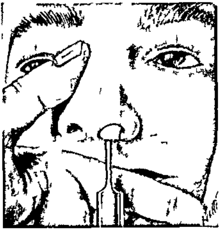


Fig 824—Nasal fra tu e

In the event of any difficulty the break should be treated by a rhinologist

Fractures of the Malar Bones—Fractures of the malar bones result from a direct blow and are usually depressed Edema may mask the deformity until several days have elapsed Palpation easily detects the break

The malar fragment may be depressed against the mandible of the jaw Elevation is accomplished by means of a hook which lifts the zygomatic arch This is held in position by the comminuted ends of the bony *fragment*

Fractures of the Mandibles and Maxillae—Fractures of the mandibles usually result from blows on the jaw The fracture is practically always compounded into the mouth and infected

Fractures of the mandibles are treated by *reduction* and *immobilization* by wiring the teeth the upper jaw being used as a splint The management of this type of a fracture is best effected by the oral surgeon

* Scudder The Treatment of F actures

The *treatment* of fractures of the pelvic ring depends upon the degree of displacement and the extent of soft tissue damage If there is neither significant soft tissue damage nor displacement it is sufficient to keep the patient recumbent for six weeks Fractures with displacement require the attention of the specialist for reduction and immobilization in a *plaster spica* (p 2997) Bladder rupture calls for prompt operative repair of the viscus

Minor fractures of the pelvic ring may result from *avulsion injuries* The sprinter s fracture consists of a tear of the anterior superior or anterior inferior spine This lesion occurs characteristically as the sprinter takes off from his mark at the start of the race

The avulsion fracture is treated by immobilization of the extremity in the position of relaxation of the affected muscles This usually effects accurate approximation of the fragment If the result is unsatisfactory open reduction and fixation should be done

Fractures of the Sacrum and Coccyx —Fractures of the *sacrum* accompany extensive injury to the pelvic ring They are rarely displaced and require no particular treatment

Fractures of the *coccyx* usually result from a fall on the buttocks The diagnosis is made by palpation the bone being grasped between the outer finger on the posterior surface and the finger inserted into the rectum on the anterior surface

Usually there is no special treatment required beyond advising the patient to sit on a rubber ring In the erect position the patient is taught to hold the buttocks well together and flatten the lumbar lordosis Thus the coccyx is immobilized in a muscular splint

Coccydynia may persist for six months to a year If the pain is sufficiently incapacitating the fragment may be operatively removed

In injuries severe enough to fracture the coccyx there is an associated *sacro iliac ligamentous injury* (p 3063) This must be treated by support

The Management of Paraplegia Accompanying Fractures of the Spine — Paraplegia may be associated with fractures of the spine at any level The paralysis may be *complete* or *incomplete* Just as in fractures of the skull the injury to the central nervous system outweighs in importance the *trauma* to the bony structures

Complete paraplegia is readily recognized by strongly flexing and compressing the toe In the presence of normal sensation this maneuver should produce severe pain Absence of sensation points to a complete paraplegia With any recognition of the discomfort the lesion is probably incomplete Neurologic disturbances in *urination* and *defecation* accompany the paraplegia *Retention of urine* and *distention of the bladder* are particularly to be avoided

Complete transection of the cord offers little or no hope of recovery Partial injury is often followed by adequate restitution of function though some residual paralysis may persist

Paraplegia associated with injuries in the *lumbar region* offers the best prognosis since at this point the cauda equina does not completely fill the vertebral canal In the thoracic and cervical regions where the cord is expanded and snugly fits into the bony canal it is more vulnerable and recovery is less likely to be complete

TABLE 1 8—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF THE SHOULDER GIRDLE AND UPPER EXTREMITIES (Continued)

Site	Clinical Manifestations and Treatment
Shaft of Ulna	Rarely displaced Immobilize from knuckles to mid humerus for ten to twelve weeks If displaced and shortened look for dislocation of radial head (Monteggia) Under these circumstances reduce under anesthesia and immobilize as above
Shaft of Radius	Usually no displacement unless there is accompanying fracture of ulna or lower radio-ulnar dislocation Reduce if necessary Immobilize in plaster from knuckles to upper humerus for ten weeks
Shafts of Radius and Ulna	If undisplaced, apply plaster of paris from knuckles to mid humerus and maintain for six to twelve weeks Check to observe tendency of fragments to slip With displacement and overriding summon orthopedic specialist for reduction by traction and manipulation Exert traction over thumb pull directly distally in line with shaft of radius May require strong efforts for five to twenty minutes Then manipulate by lateral pressure and rotate in appropriate direction under fluoroscopic control Fractures of upper portion must be set with lower forearm in supination Those below level of insertion of pronator teres are put up in midposition Fractures of lower end maintained in ulnar deviation
Greenstick Fractures of Shafts of Both Forearm Bones	Angulation usually convex toward volar surface Reduce on wooden board by placing forearm dorsal side downward and exerting pressure over volar projection Apply plaster bandage from knuckles to upper humerus with elbow at 90 and forearm in midpronation Maintain for six to twelve weeks
Lower End of Radius (Colles)	Very frequently encountered Due to fall on outstretched hand If undisplaced immobilize in plaster for six weeks in slight dorsiflexion and ulnar deviation With dorsal displacement of lower fragment (silver fork deformity) look for evidences of injury to ulnar styloid Take films in two planes and note that radial styloid should extend below ulnar styloid articular surface of lower end of radius should be tilted volarly at 15 to perpendicular of long axis Reduce under local or general anesthesia Grasp injured hand with corresponding hand of physician Employ strong traction in order to deviate hand toward ulnar side bring into extreme palmar flexion Maintain position of slight dorsal flexion with enough ulnar deviation so that shaft of first metacarpal is in line with radius Check positions of radial and ulnar styloids and of articular surface of lower end of radius If satisfactory apply plaster from knuckles to below elbow Immobilize for six to ten weeks but advise active exercises for all joints not involved *If fracture is irreducible or if fragments slip refer to specialist*
Displacement of Lower Radial Epiphysis	In children in place of Colles fracture Epiphysis displaced upward and tilted dorsally Reduce by simple pressure downward Mold plaster carefully to prevent slipping of fragments
Carpal Scaphoid	Second in frequency to Colles fractures Note weakness of grip and localized tenderness over scaphoid in anatomic snuff box Take AP lateral and oblique x rays Unless markedly displaced immobilize in unpadded plaster gauntlet extending from knuckles to just below elbow Use position of slight dorsiflexion and ulnar deviation as in Colles deformities Maintain immobilization for six weeks and check on x rays If union is delayed consult specialist since aseptic necrosis of distal fragments may occur

TABLE 158.—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF THE SHOULDER GIRDLE AND UPPER EXTREMITIES

Most fractures of the shoulder girdle and upper extremities can be managed by the practitioner Those frequently encountered include breaks of clavicle humerus and lower end of radius (Colles) In these, the deformity usually is palpable and reduction can be accomplished under local or general anesthesia with reasonable satisfaction

Site	Clinical Manifestations and Treatment
Clavicle	Usually in middle third Inner fragment angled upward by sternocleidal mastoid Outer fragment and shoulder dropped and pulled inward by muscles of shoulder Reduce and immobilize by holding shoulder backward upward and outward Use figure-of-eight bandage or clavicle splint Maintain immobilization for 4 weeks Insert large axillary pad to prevent pressure and wedge shoulder outward Avoid Velpeau bandage Open reduction if fragment cannot be held
Scapula	Usually linear from direct violence Immobilize by use of sling
Greater Tuberosity of Humerus	Upper fragment displaced by pull of abductors of shoulder Immobilize in salute position with 90 of abduction 45 of forward flexion and external rotation Use plaster arm spica or airplane splint
Neck of Humerus	Immobilize in sling or swathe if there is no significant displacement Encourage early active motion by swinging arm Discard sling after 4 to 6 weeks Start gravity exercises in 10 days
Shaft of Humerus	Usually transverse or spiral Formerly treated with plaster spica with elbow at 90 to arm and arm at 90 abduction from body More modern technic advocates hanging plaster Apply cast from knuckles to arm pit with elbow at 90 of flexion Use padding for comfort Patient sleeps in semi recumbent position Check for evidences of paralysis of radial nerve
Supracondylar Fractures of Humerus	Very frequent in childhood and adolescence as result of indirect violence Backward projection of elbow with disturbance of relationship of internal and external epicondyles to tip of olecranon Reduce under local or general anesthesia with traction in line of forearm and counter traction on anterior surface of lower end of upper fragment Flex forearm to acute angle Apply posterior molded plaster splint to maintain arm in acute flexion with wrist in pronation Beware of injury to ulnar nerve and development of ischemic contractures (p 3025) Compare radial pulse with that of uninjured arm If obliteration of pulse is not due to position, suspect subfascial hemorrhage and prepare for evacuation of clot.
Transcondylar and Intercondylar Fractures of Humerus	Requires radiographic demonstration Frequently comminuted Refer to specialist for continuous traction
Head of Radius	From fall on outstretched hand Marked limitation of pronation and supination at elbow Take radiograph in several planes Immobilize in posterior molded splint for three weeks Irreducible fractures require open operation by specialist.
Olecranon	If not displaced treat with simple immobilization in extension at 160 If displaced suggest open operation for suture or metallic fixation of fragments
Ulnar Coronoid	Usually associated with posterior dislocation of elbow and fracture of radial head If displacement is not marked immobilize in flexion
Epiphyseal Injuries at Elbow	See below

The bandage is made from stockinette padded with sheet wadding in the axilla and reenforced with adhesive plaster The figure of eight bandage is renewed every three or four days for the first two weeks Immobilization is continued for approximately four weeks until healing is firm

In children the immediate result need not be cosmetically perfect A good deal of remodeling may be expected throughout the period of growth

Where appearance is particularly important as in women who wear low cut evening dress a better result may be achieved with the aid of the *Bohler splint* (Fig 2974)

The old fashioned *Velpeau bandage* is not recommended It unneces sarily immobilizes elbow wrist and fingers Particularly in elderly patients full range of finger motion may be permanently lost following its use

If the fragments cannot be held by bandaging *open reduction* may be required Rustless steel wire is passed *through the length of the clavicle*



Fig 82.—Roentgenogram showing typical deformity in a fracture of the middle third of the clavicle

insuring the maintenance of perfect alignment No other immobilization is required and the patient resumes activity within a week

FRACTURES OF THE SCAPULA

Fractures of the scapula are usually linear They result from direct violence There is rarely much displacement since the attached muscles splint the fragment effectively

The fracture is adequately immobilized by the use of a sling

Fractures of the *glenoid cavity* involving the shoulder joint are more serious They require the attention of the specialist since open reduction may be necessary

Many fractures of the glenoid are of the fissured or stellate type If there is no damage to the head of the humerus or the joint these frac tures need protection until the acute reaction has subsided Following this exercises are instituted to reestablish shoulder motion (See *Fractures of Surgical Neck of Humerus* (p 3018))

Conwell in Christopher A Textbook of Surgery

TABLE 158—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF THE SHOULDER GIRDLE AND UPPER EXTREMITIES (*Continued*)

Site	Clinical Manifestations and Treatment
Perilunate Fracture Dislocations of Carpus	Combination of fracture of scaphoid and dislocation of wrist Reduce under anesthesia by traction Immobilize in unpadded plaster gauntlet as above
Shaft of First Metacarpal	Generally transverse and angulated with convexity toward radial side Reduce manually Immobilize for three weeks with thumb in full abduction and extension
Lower End of Shaft of First Metacarpal (Bennett)	Generally oblique with extension into joints May be accompanied by dislocation of carpo metacarpal joint If reduction cannot be maintained by simple abduction and extension institute skin traction with moleskin adhesive Refer to specialist for traction through safety pin transfixed into pulp of thumb Immobilize for three to four weeks
Second to Fifth Metacarpals	Most frequent of neck of fifth metacarpal Usually with angulation and dorsal convexity Reduce by manipulation Splint to next finger flexing metacarpo-phalangeal and proximal interphalangeal joints at 90 Use padded plaster around fingers and continued around fore arm almost to elbow
Shaft of Metacarpals	Usually oblique or spiral With overriding Immobilize for three or four weeks in plaster gauntlet from knuckles to mid forearm
Neck of Metacarpals	If undisplaced immobilize in plaster gauntlet extending to proximal interphalangeal joint Leave other fingers free
Phalanges	Rarely displaced Immobilize in slight flexion on metal splint Fractures of shafts of proximal phalanges may be angulated with convexity toward palm After reduction immobilize in flexion with traction applied through wire or safety pin which transfixes pulp of finger Maintain with knuckle at 45 proximal interphalangeal joint at 90 and distal interphalangeal joint at 45 Mallet finger requires immobilization for six weeks in flexion of proximal interphalangeal joint and hyperextension of distal interphalangeal joint Use circular plaster of Paris bandage and hold for six weeks

Fractures of the maxillae may be complicated by extension into the nasal accessory sinuses

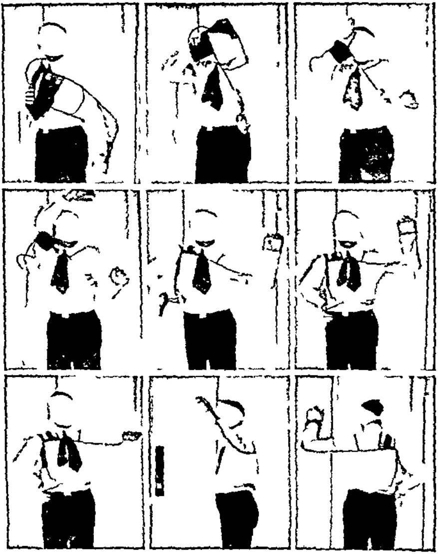
A fourtailed bandage effectively supports the chin until more expert treatment can be obtained

FRACTURES OF THE CLAVICLE

The clavicle is usually broken in the middle third where the bone is unprotected by muscle attachments The *inner fragment* is angled upward by the pull of the sternocleidomastoid muscle The *outer fragment* and the *shoulder* are dropped and pulled inward by the muscles attached to the shoulder As a result of these muscle pulls the fragments override Despite the close proximity of large vessels and nerves there is seldom any deep injury The fracture is rarely compound

Effective *treatment* requires holding the shoulder backward upward and outward so that the fragments are brought into apposition In children successful results are obtained by using a simple figure of eight bandage about both shoulders pulling upward and backward A large axillary pad prevents pressure and acts as a wedge to pry the shoulder outward

the range of motion improves the patient is taught to adduct the shoulder by climbing his fingers up a wall A mark should be made on the wall of the highest point reached and an effort made to better the record each day The return of function is surprisingly great despite the marked de



Fi 527—Cleary modification of aeroplane splint showing adjustments and positions Illustrative of all ambulatory abduction splints none of which is satisfactory

formity demonstrable by radiograph The avoidance of long periods of recumbency is especially valuable in older patients

Displaced fractures in the young adult and displacement of the upper

From Magnuson and Coulter in International Clinics vol v Series 30 J B Lippincott Co Publishers

FRACTURES OF THE HUMERUS

Fractures of the humerus occur through the greater tuberosity the neck the shaft or the condyles in the region of the elbow joint

Fractures of the Greater Tuberosity—Fractures of the greater tuberosity of the humerus are *generally displaced by the pull of the abductor muscles* of the shoulder on the upper fragment

Treatment involves immobilization of the arm in the salute position of 90 degrees of abduction, 45 degrees of forward flexion and external rotation The lower fragment is thus brought into contact and alignment with the upper fragment. The salute position is achieved by the commercial *airplane splint* If this is not available a plaster arm spica may be applied

When the greater tuberosity is not displaced immobilization in abduction is unnecesary The simple use of a sling for two or three weeks suf



Fig 826—Fracture of the anatomical neck of the humerus (Massachusetts General Hospital series) Note changed relations of articular surface of humerus and shaft of humerus

fices In any case *active motion is instituted at the earliest possible moment* In fractures without displacement this can be accomplished within the first few days The arm is permitted to swing free in its sling while the patient bends forward A gentle to and fro swinging motion is accomplished without straining the fracture

Fractures of the Neck of the Humerus—Fractures of the neck of the humerus accompanied by no significant displacement do not require manipulative reduction Simple immobilization in a sling and swathe suffice Early active motion by the swinging technic is encouraged Exercises are begun after the first week and are increased until a substantial range of motion returns At the *end of four to six weeks* the sling is gradually discarded

Active abduction exercises are started after three or four weeks As

Scudder *The Treatment of Fractures*

Fracture of the Shaft of the Humerus—Fractures of the shaft of the humerus are usually transverse or oblique (spiral) The latter often results from muscle violence as in throwing a ball or playing handball Delayed union and nonunion not uncommonly follow fractures of the transverse variety This is the third most frequent site of nonunion in the body

The *treatment* of fractures of the shaft was formerly carried out by means of a *plaster spica* or *traction* with the elbow at 90 degrees to the arm and the arm abducted at 90 degrees from the body More recently the *hanging plaster* method has been advocated A plaster cast is applied from knuckles to armpit with the elbow at 90 degrees of flexion The plaster is padded for comfort The patient is ambulatory but must *sleep* in a *semirecumbent* position

Traction is made by the weight of the plaster cast which is suspended at the wrist In the hanging plaster method immobilization of the fragment is accomplished by the traction that is obtained

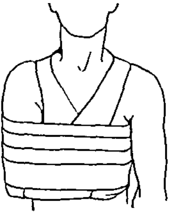


Fig 8.0—Sling and swathe for fracture of upper end of humerus Removable for gravity exercise

Radial Nerve Paralysis—Paralysis of the radial nerve frequently accompanies fractures of the shaft of the humerus The nerve is close to the bone It may be injured at the time of the fracture or become involved later by inclusion in the callus

Radial paralysis occurring at the time of fracture usually recovers without operative intervention if reduction of the fragment is successfully accomplished If there is no improvement after four to six weeks operative exploration and neurolysis is indicated

Fractures of the Lower End of the Humerus—Fractures of the lower end of the humerus are considered with the *lesions of the elbow joint*

FRACTURES OF THE ELBOW

Fractures of the elbow joint may involve the condyles of the humerus the upper ends of the radius and ulna the condylar epicondylar and upper radial epiphyses in children

* Darrach Murray and Marble Treatment of Fractures, American College of Surgeons

humeral epiphysis in the young require manipulative reduction and immobilization in a plaster spica



Fig 828—Roentgenogram of a fracture through the high surgical neck of the humerus Note rotation of proximal fragment in abduction and position of upper end of distal fragment beneath glenoid in axilla (Healey)



Fig 829—Lateral view of comminuted fracture of the shaft of the humerus Note spiral and oblique lines of fracture Displacement and shortening There was no nerve involvement

Joints not immobilized are actively exercised from the first day of treatment

* Scudder The Treatment of Fractures

When the reduction is satisfactory a *posterior plaster molded splint* is applied to maintain the arm in acute flexion with the wrist in pronation

The *radial pulse* is palpated frequently If it is obliterated the elbow should be extended and flexed in a position 10 degrees beyond the point at which the pulse becomes palpable Once good position has been secured the most important part of the immediate after treatment is the observation of the local circulation This should be done at frequent intervals for the first few days Only in this way may *ischemic contracture* (p 3025) be avoided On occasions when the radial pulse cannot be felt even with the elbow fully extended the circulatory obstruction may be assumed to result from a *subfascial hemorrhage* Immediate operation with evacuation of the blood clot must be done

Transcondylar and Intercondylar Fractures—Transcondylar and intercondylar fractures of the humerus occur at a lower level than the supracon

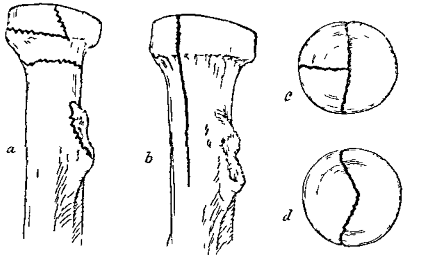


Fig 83 —Possible fracture lines of head and neck of radius, *a* head, neck and tuberosity *b* head and upper end *c d* head *

dylar fractures They extend through the lower end of the humerus which appears broadened on anteroposterior radiographs but which is actually very thin and narrow when viewed laterally

These fractures are frequently comminuted From the radiograph it is often impossible to make out any pattern

Fractures of this type are best referred to the specialist orthopedist who manages them by a type of continuous traction

Fractures of the Head of the Radius—Fractures of the head of the radius usually result from indirect violence The radial head is forced against the capitellum of the humerus and a bony crack is produced

All degrees of fracture may be observed from a mere crack to a comminuted displaced fracture of the entire head A frequent type of break is the so-called chisel fracture in which a segment of the articular sur

* Moorhead, Clinical Traumatic Surgery

Fractures of the elbow present many difficult problems The anatomy is complicated The elbow does not take kindly to passive motion and vigorous massage Overzealousness may actually hinder return of function There may be injury to the *ulnar nerve* subfascial hematomas and *ischemic contracture* resulting from improper splinting or immobilization In children the presence of the various epiphyses adds to the difficulty

The normal elbow presents a slight *valgus angulation* producing the carrying angle This is best observed in full extension It varies in different individuals Comparison with the opposite elbow is invaluable in estimating this angle

Roentgenograms of the opposite joint are of immeasurable aid in evaluating epiphyseal injury in children

Supracondylar Fractures of the Humerus —Supracondylar fracture of the humerus is the commonest type observed in childhood and adolescence It is caused by indirect violence transmitted along the bones of the fore

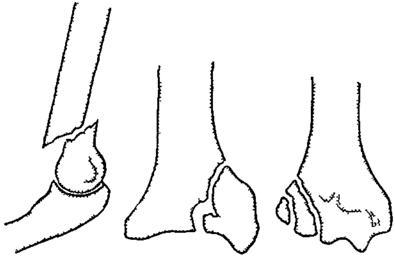


Fig 831 —Fractured humerus *A* Supracondylar type *B* Internal (medial) condylar type *C* External (lateral) condylar type

arm The articular surface of the humerus is driven backward causing a fracture an inch or two above the joint

Supracondylar fractures of the humerus are rarely seen in adults in whom a similar type of injury usually causes dislocation of the elbow

The *diagnosis* of supracondylar fracture can usually be made on inspection There is a backward projection of the elbow while the relationship of the internal and external epicondyles to the tip of the olecranon is undisturbed

Reduction of the supracondylar fracture is effected under local or general anesthesia *Traction* is made in the line of the forearm *countertraction* on the anterior surface of the lower end of the upper fragment While this is maintained the forearm is slowly flexed to an acute angle the traction having brought the lower fragment forward and opposite the upper fragment If the position is not satisfactory the manipulation is repeated

* Moorhead, Clinical Traumatic Surgery

muscles of the forearm They pull the fractured fragment downward

Lesser degrees of displacement of the internal epicondylar epiphysis are treated by immobilization with the forearm in flexion and pronation Union will be satisfactory even if only fibrous

More marked degrees of displacement require open operation and fixation The fragment may be locked between the articular surfaces having been displaced into the joint itself The ulnar nerve may be damaged

3 *Displacement of the upper radial epiphysis* is caused in the child by the same type of injury which would result in a fracture of the radial head in an adult

Minor degrees of displacement to one side or the other cause no later trouble and need not be reduced If there is tilting or major displacement of the articular surface manipulative reduction should be attempted If this fails it is necessary to consult the specialist orthopedist Open reduction and reposition or removal of the fragment may be necessary Following this immobilization is carried out in a plaster cast extending from knuckles to elbow

Complications of Elbow Injuries—Injuries to the elbow may be complicated by ischemic contracture injury to the ulnar nerve or growth deformities

Ischemic Contracture—Ischemic contracture (Volkmann) was previously believed to result from improper splinting and immobilization However the damage to the circulation may occur at the time of the fracture and be independent of subsequent treatment A sharp bony spicule of the projecting fractured fragment may lacerate vessels or cause vascular spasm When the fresh fracture is seen evidences of vascular impairment should not contraindicate reduction but rather encourage early and accurate reposition Failure of the radial pulse to return despite reduction demands consultation with the specialist since it may be necessary to incise the deep fascia to relieve tension in the antecubital fossa

After reduction of the fracture the patient should remain under observation for the first few days of immobilization Should the radial pulse disappear or the fingers become cyanotic and cold the degree of flexion must be reduced If necessary the position of the fragment is neglected in order to restore the circulation to the part

Since medicolegal consequences may be associated with an ischemic paralysis the practitioner should consult a specialist when confronted with this complication

Nerve Injuries—Injuries to the *ulnar nerve* frequently occur with elbow fracture Displacements of the internal epicondylar epiphysis may directly injure the nerve It may be stretched or torn when the elbow is deviated into valgus at the time of injury

Late ulnar paralysis develops with pronounced valgus deformities The ulnar nerve is stretched around the convex or elongated side of the elbow After a variable period of time which may be years signs of ulnar neuritis (tingling numbing weakness and atrophy) may appear Anterior trans

face breaks off cleanly as if by the blow of a chisel Usually the fragment is depressed about a millimeter below the joint level

Fracture of the radial head is suspected when there is a history of a fall on the outstretched hand The suspicion is strengthened when there is limitation of pronation and supination of the elbow even though flexion and extension are fairly free Tenderness is usually elicited over the radial head

It may be necessary to take radiographs in several planes to reveal the entire periphery of the radial head

The *treatment* of these fractures depends on the extent of the injury Crack fractures and minor chisel fractures which involve a small portion of the total articular surface are treated by immobilization in a posterior molded splint After three weeks active exercise is encouraged

Injuries of greater severity often require open operation by the specialist consultant It is usually necessary to excise the entire radial head Optimal results are obtained if this is done within the first week Delayed operation results in limitation of range of motion since the joint will have been already irreparably damaged

Fractures of the Olecranon —Fractures of the olecranon interrupt the extensor apparatus of the elbow and are analagous to fractures of the patella in the knee They are often compound Minor degrees of break *without displacement* are treated with simple immobilization in extension at 160 degrees Fractures *with displacement* require open operation since the fragment can only be held by suture or metallic fixation

Fractures of the Coronoid Process of the Ulna —Fractures of the coronoid process of the ulna frequently accompany posterior dislocation of the elbow and fracture of the radial head

If the fragment is not markedly displaced immobilization in flexion will suffice to produce adequate healing The accompanying injury is usually of more importance than the fracture of the coronoid itself

Epiphyseal Injury to the Elbow —Epiphyseal separations should really be termed juxta epiphyseal fractures since the fracture line is generally through the metaphysis just proximal to the epiphyseal line

The interpretation of the radiograph in epiphyseal injuries is fraught with many dangers The displaced fragment seen radiographically is only the central calcific nucleus of the epiphysis The surrounding mass of cartilage does not cast a shadow If the displaced epiphysis has not yet ossified it may not be visible Only by careful comparison with the radiograph of the sound elbow and the use of films taken in many planes is it possible accurately to interpert the extent of the joint injury

Because of the grave potentialities of epiphyseal injury the advice of a *specialist consultant* is greatly to be desired

1 The *external condylar epiphysis* may be rotated or even completely displaced out of the joint If reduction does not secure adequate alignment the consequences may be serious Inadequate reduction results in arrest of bone growth and increased valgus deformity of the elbow since the internal side of the joint continues to grow In marked deformities late ulnar paralysis may develop
2 The *internal epicondylar epiphysis* does not enter the joint of the elbow proper It is the site of origin of the flexor and pronator

These fractures are usually not markedly displaced They do not require reduction

Fractures of the ulnar shaft with displacement and shortening but without accompanying fracture of the radial shaft are usually associated with dislocation of the radial head (*Monteggia fracture*) It is important that the radiograph include not only the point of possible fracture but the elbow joint as well

Plaster bandages for immobilization of the fractures of the ulnar shaft extend from the knuckles to the mid humerus to prevent rotational stress Union may require ten to twelve weeks

Fractures of the Shaft of the Radius—Fractures of the shaft of the radius may result from direct or indirect violence There is usually no displacement With overriding of the fragment in the absence of an accompanying fracture of the ulna a lower radio ulnar joint dislocation should be suspected

A fracture of the lower portion of the shaft of the radius is often difficult to reduce when the ulna is intact If there is an associated greenstick fracture of the ulna this may have to be broken up before the radial fragment can be aligned

Immobilization is carried out in a plaster bandage extending from the knuckles to the upper humerus It is maintained for a period of at least ten weeks

Fractures of the Shafts of the Radius and Ulna—Fractures of the shafts of both forearm bones may occur at any level from the biceps insertion to a point 1 inch above the wrist joint In the upper part of the forearm palpation is difficult due to the overlying thick muscular layers In the lower forearm the bones are subcutaneous The ulna has one subcutaneous border throughout its entire length

In fractures of both bone of the forearm *without displacement* it is sufficient to apply a plaster of paris bandage from the knuckles to the mid humerus The position should be checked frequently during the first few weeks because of the marked tendency of the fragments to slip Plaster should remain on for six to twelve weeks

In fractures of both bones of the forearm with displacement and overriding the services of an orthopedist specialist should be secured If these services cannot be obtained reduction is accomplished by traction and manipulation under local or general anesthesia

Traction is exerted principally upon the thumb which is pulled directly distally in a line with the shaft of the radius After five to twenty minutes of steady strong traction the bones should be pulled down to their original length They are then manipulated by lateral pressure and rotated in the appropriate direction Reduction under fluoroscopic control is usually advantageous

If the fracture is in the *upper fleshy part of the forearm* the upper portion of the radius is supinated by the action of the supinator and the biceps muscles Consequently in reduction the lower forearm must be placed in a similarly supinated position

Fractures *below the level of the insertion of the pronator teres* are put up with the forearm in mid position since the upper fragment has both pro and supinatory muscle pull

position of the ulnar nerve (moving the nerve anteriorly to the internal epicondyle) is a satisfactory operation producing relief of symptoms

Growth Deformities —Changes in the carrying angle may result from injury to the elbow epiphyses particularly during periods of growth Increase in the carrying angle (*cubitus valgus*) and decrease (*cubitus varus*) may follow improper reduction of supracondylar and transcondylar fractures or epiphyseal injuries When fully developed the chief complication

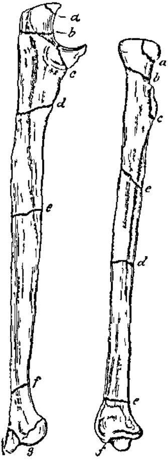


Fig 833 Fig 834

Fig 833 —Fracture lines of ulna *a b c* olecranon *d e f* shaft *g* styloid
Fig 834 —Fracture line of radius *a* head *b* neck *c* tuberosity *d e* shaft *f* styloid

is late *ulnar paralysis* The deformities themselves may be corrected by supracondylar osteotomy

FRACTURES OF THE SHAFTS OF THE FOREARM BONES

Fractures of the shafts of the forearm bones may involve the ulna alone the radius alone or both bones

Fracture of the Shaft of the Ulna —Isolated fractures of the shaft of the ulna are generally caused by direct violence such as warding off a blow

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Fig 836—Colles fracture high comminuted type with fracture of ulnar styloid *Upper* before and *lower* after reduction and splintage *

of the ulnar styloid Children may suffer displacement of the lower radial epiphysis The more common fractures of the carpus include those of the scaphoid

Fracture of the Lower End of the Radius (Colles) —Fractures of the

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In fractures near the *lower end of the forearm bones* the lower fragment of the radius is frequently pulled inward by the tension of the pronator quadratus muscle This is partially relaxed by the position of pronation The principal insurance against inward deviation of the lower radial fragment is obtained by placing the hand in a position of ulnar deviation

Fractures of the Shaft of Both Forearm Bones in Children —*Greenstick Fractures* —Greenstick fractures frequently occur in children and adolescents The angulation presents a convexity towards the volar surface

Reduction is accomplished by placing the forearm upon a wooden board dorsal side downward The volar projection is reduced by palmar pressure by the operator One or two fingers are placed beneath the dorsal aspect of the wrist to permit slight overcorrection This procedure is so rapid that it causes less discomfort than would be produced by the induction of local anesthesia

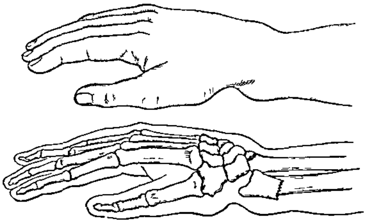


Fig 835 —Colles fracture *Upper* external appearance with radial deviation *lower* fracture line with postero external displacement and fracture of ulna styloid

A plaster of paris bandage is applied from the knuckles to the upper humerus with the elbow at 90 degrees and the forearm in mid pronation While the plaster is setting slight pressure should be made by the operator s palm and distributed evenly over a considerable area of the volar surface of the forearm This restores the normal volar concavity Radiographic evidence of union is generally noted in from six to twelve weeks

Fractures of both bones of the forearm with displacement in children are treated exactly as are the fractures in adults However in the growing child a great deal of remodeling of bone may be expected The surgeon is therefore justified in accepting a result which is short of perfect in the expectation that time will repair this deficiency to a large degree

Open reduction of forearm fractures is rarely indicated in the growing child

FRACTURES OF THE WRIST

Fractures of the wrist are of very common occurrence particularly *Colles fracture* of the lower end of the radius with or without involvement

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Reduction makes use of the hand as a lever to move the lower small fragment to which are attached the ligaments of the wrist joint The usual fracture is impacted and displaced To reduce this deformity, the hand of the patient is firmly grasped by the corresponding hand of the physician (right to right) Strong traction is employed The hand is deviated toward the ulnar side and then brought into extreme palmar flexion This movement pulls on the ligaments of the wrist which are attached to the radial *and dorsal side of the lower fragment Dorsal angulation and radial shortening* are corrected by this maneuver With a firmly impacted fracture a fair degree of force has to be employed Transverse fractures with displacement and overriding are reduced by traction and manipulation as in fractures of the shafts

When reduction has been accomplished the hand is maintained in a position of slight *dorsal flexion* with enough *ulnar deviation* so that the

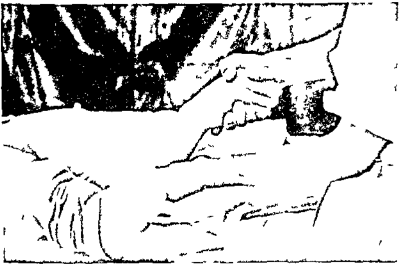


Fig 838—Traction to overcome overlapping in Colles fracture

shaft of the first metacarpal is in line with the radius The lower end of the radius and the position of the styloid are determined by palpation

If the reduction is satisfactory plaster is applied in this position The cast extends from the knuckles to below the elbow Radiographs are taken in two planes to check the accuracy of the reduction

Immobilization is continued for six to ten weeks During this time active exercises and use of all joints except the wrist are practiced

Badly *comminuted fractures* of the lower end of the radius are *molded* back *into position by manual pressure using the heel of the hand* This is practiced both in the anteroposterior and lateral position before and after the plaster is applied and while the position is maintained by traction

Displacement of lower radial epiphysis—In children in lieu of a Colles fracture a displacement of the lower radial epiphysis may occur In the usual type the epiphysis is displaced upward and tilted dorsally Reduc

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lower end of the forearm without displacement need no reduction They are immobilized for six weeks in the *position of slight dorsiflexion and* ulnar deviation

Colles Fracture—Colles' fracture is a break of the lower end of the radius occurring within one inch of the wrist Characteristically there is a dorsal displacement of the lower fragment giving the typical silver fork deformity

The typical history of a Colles fracture is that of a fall upon the out stretched hand Bone tenderness may be elicited over the lower end of the radius and the ulna as well if the styloid process has been simul taneously involved Dorsal displacement of the fragment gives rise to the *silver fork deformity*

Radiographs are made in two planes since the displacement may be noted only in the lateral view Two important anatomic facts are noted

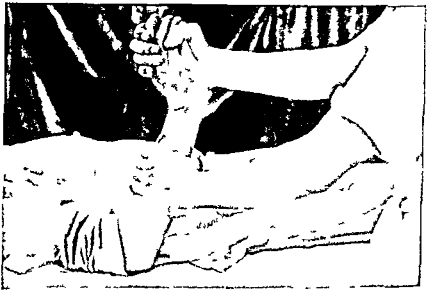


Fig 837—Dorsal flexion to disengage fragments in Colles fracture

radiographically (*1*) the radial styloid should extend below the ulnar styloid (*2*) the articular surface of the lower end of the *radius should* be tilted volarly about 15 degrees to the perpendicular of the long axis In the usual fracture the articular surface is tilted in the opposite direction Unless this deformity is corrected there will be subsequent limitation of palmar flexion at the wrist

The *Colles fracture usually is reduced under local anesthesia* Children and uncooperative individuals require general anesthesia Following anes thetization an index of the amount of dorsal angulation in the lower fragment is obtained by noting the amount of limitation of palmar flexion This may be obscured if the wrist is very greatly *swollen*

The *reduction of* the Colles fracture concerns itself with the radial break When this is well aligned the ulnar fracture usually accompanies the radial fragment into position

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placement Indeed unreduced displacements of this sort usually realign themselves in the course of time without deformity

Severe fractures which extend completely through the epiphyseal plate and those that are accompanied by marked crushing of this tissue are often accompanied by *disturbances in growth* Parents should be warned of this possibility at the time of the accident Periodic checkups and radiographs are desirable for several years thereafter Immobilization should be continued for at least six to eight weeks

Fractures of Carpal Scaphoid—Fractures of the carpal scaphoid are more common than is generally recognized They are second only in frequency to fractures of the lower end of the radius Formerly nonunion was a frequent sequel With the use of unpadded plaster and careful treatment this complication should rarely be observed

Fracture of the carpal scaphoid is generally caused by indirect violence driving the scaphoid against the articular surface of the radius This type of trauma may be produced by a fall on the hand or a powerful blow with the fist

Clinically fracture is suspected when the grip is weakened and there is well localized tenderness over the scaphoid bone in the region of the



Fig 841—Gauntlet for carpal navicular fracture Metacarpophalangeal joints and terminal thumb joint should be free Upper end should be just distal to elbow joint

anatomic snuffbox There may be little swelling Pressure transmitted along the first or second metacarpal shaft produces pain in this region

Radiographs taken in the anteroposterior lateral and oblique views may demonstrate the fracture line However even excellent radiographs may fail to show the break for at least a week At the expiration of this interval resorption of bony trabeculae along the fractured surfaces produces a visible fracture line in the radiograph

This circumstance makes it unwise to diagnose a sprain of the wrist on the basis of one normal radiograph Subsequent investigation at the end of the week will result in diagnosing many fractures which would ordinarily be treated as sprains with consequent nonunion

Fractures of the carpal scaphoid are rarely displaced It is sufficient to *immobilize* them in a well fitting unpadded plaster gauntlet from the knuckles to just below the elbow joint Union can be expected only if the immobilization is complete and uninterrupted The quality of the treatment determines the excellence of the result The fingers need not be immobilized The position is one of slight dorsiflexion and ulnar deviation exactly similar to that used for the Colles fracture

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tion is easily accomplished by simple pressure downward upon the displaced epiphysis However these fractures have a tendency to slip while the plaster is being applied To prevent this the plaster should be carefully molded while it is setting



Fig 839.—Palmar flexion in Colles fracture



Fig 840—Ulnar deviation in Colles fracture Note bandage in palm to maintain wrist flexion and ulnar deviation the "mailed fist" position *

Overcorrection of the e displacements is virtually impossible Excellent anatomic reduction is the rule

There is generally no disturbance of growth from this type of dis-

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placement Indeed unreduced displacements of this sort usually realign themselves in the course of time without deformity

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Darrach Murray and Marble Treatment of Fr[illegible] A[illegible]er[illegible]n Coll[illegible]ge [illegible]f Surgeons

The plaster must be changed if it softens or becomes loose At the end of six weeks the plaster is removed The fracture site is tested for tenderness The radiograph is taken Unless there is clear radiographic evidence of union the plaster is reapplied for another period of four weeks

Delayed union or *nonunion* of the carpal scaphoid is seen in neglected or improperly treated cases If there is motion between the fragments there may be cystic reabsorption of bone at the fracture line This causes persistent pain and swelling as well as disability Nonunion may still respond well to prolonged and complete immobilization in plaster If the fracture line has been sealed off by a process of eburnation nonunion is established Immobilization no longer suffices The patient is referred to the specialist orthopedist for operative treatment by bone graft

In fractures through the proximal part of the scaphoid the *blood supply* to the distal fragment may be disturbed Radiographs at this time show increased density of the fragment, indicating that aseptic necrosis has occurred At times prolonged immobilization produces revascularization of the fragment and eventual union However damaged cartilage will not regenerate The radiocarpal joint may be the seat of later osteoarthritic change preventable only by early removal of the necrotic fragment

Perilunate Fracture Dislocation of the Carpus—Perilunate fracture dislocation of the carpus is a combination of a fracture of the scaphoid and a dislocation of the wrist The lunate and proximal half of the scaphoid remain in articulation with the lower end of the radius The remaining wrist bones are dislocated often tearing the styloid of the radius and the ulna at the same time

Reduction is by traction and manipulation Immobilization is continued until the scaphoid has united

FRACTURES OF THE HAND

The hand of the laborer or artisan is his most precious possession Minor disability in fine movements may result from imperfect treatment of seemingly minor fractures In consequence their management must be executed with the greatest care and precision

Fractures may occur in the *metacarpals* or the *phalanges* The hand is frequently subjected to *crushing* and *compound* injury The tendons and nerves are superficial and poorly protected by skin and subcutaneous fat In elderly individuals prolonged immobilization of uninjured fingers produces stiffness and limitation of motion Immobilization should be restricted to the affected finger the remaining digits being moved through their range of motion many times daily

Fracture of the First Metacarpal—The thumb is the most important digit Disability or amputation of the thumb results in loss of prehensile activity The victim is as incapable of executing fine manual movements as is the dog with his paw or a horse with his hoof

Fractures of the *shaft of the first metacarpal bone* that do not enter the joint are generally transverse and angulated with the convexity toward the radial side

These fractures are reduced manually Immobilization is maintained for three weeks with the thumb in full abduction and extension The

terminal joint of the thumb is left free Complete restoration of function is the rule

Bennett's Fracture—Fractures of the *lower end of the shaft* are generally oblique and extend into the joint Usually they are accompanied by dislocation of the carpometacarpal joint (Bennett's fracture)

A large proportion of Bennett's fractures cannot be maintained in position by simple abduction and extension They require skin traction employing moleskin adhesive

Should the fragment slip the patient is to be referred to the specialist orthopedist The pulp of the thumb is then transfixed with a sterile safety pin Traction is applied by one or two small rubber bands extending from the ends of the safety pin to a malleable metal splint incorporated in a plaster of paris gauntlet To prevent motion the gauntlet extends at least midway up the forearm Immobilization is continued for three to four weeks Infections of the pulp of the finger are rare if the safety pin is prevented from sliding from side to side



Fig. 842—Stave fracture of the thumb Note joint involved Note displacement of shaft of thumb metacarpal

Fractures of the Second to Fifth Metacarpals—The most frequent fracture of the second to fifth metacarpal bones involves the *neck of the fifth* This generally results from a misdirected blow with the fist which misses its mark and lands heavily on the cranium or against a wall

Fracture may be suspected from the marked *swelling* over the dorsum of the hand and the *tenderness* about one half inch proximal to the *knuckle* The normal contour of the knuckle is lost Radiographs reveal an angulation of the metacarpal with the convexity dorsally

Reduction is accomplished by manipulation After anesthesia the fragment is *mobilized* by breaking up the impaction The angulation is corrected by pressure against the middle phalanx of the corresponding finger with the metacarpophalangeal joints and the proximal interphalangeal joint flexed to 90 degrees Position is maintained by incorporating the finger in plaster after the surface of the phalanx and the dorsum of the

hand have been padded thoroughly with felt The plaster extends around the entire finger and is continued around the forearm almost to the elbow While the plaster is setting position is maintained by *mild* pressure against the middle phalanx and counter pressure over the fracture site



Fig 843—Fracture of the metacarpal of the index finger Completion of traction Pressure and counterpressure by thumb on the dorsum and on bandage in the palm of the hand



Fig 844—Fracture of the metacarpal of the index finger Completion of the application of the dressing Adhesive plaster straps holding hand and roller bandage in position *

The patient should be seen frequently during the period of immobilization since pressure sores may occur particularly over the proximal interphalangeal joint

Failure at proper reduction results in a deformity so that the knuckle is 'lost There is associated disability due to the projection of the meta carpal head into the palm

* Scudder The Treatment of Fractures

Fracture of the Shafts of the Metacarpals—Fractures of the shafts of the metacarpals are frequently of the oblique or spiral types These may not be angulated or displaced but overriding may be present If the overriding is slight simple immobilization for three or four weeks in a plaster gauntlet from knuckles to mid forearm is sufficient If marked shortening is present there may have to be continued traction upon the corresponding finger which is best left to the orthopedist specialist

Fractures of the Necks of the Metacarpals—Fractures of the necks of the metacarpals without displacement are immobilized in a plaster gauntlet that extends to the proximal interphalangeal joint The other fingers are left free Active exercise is encouraged

Fractures of the Phalanges—Fractures of the shaft of the distal phalanges are usually due to crushing injuries or direct violence They are rarely displaced to any degree They are immobilized in slight flexion on a metal splint If nothing else is available a splint may be improvised with applicator sticks bound in adhesive plaster

Fractures of the shaft of the *proximal phalanges* are more serious They are generally angulated in the reverse direction from the metacarpal shaft *i e* with the convexity toward the palm They must be immobilized in the position of flexion with traction applied by a wire or safety pin transfixing the pulp of the finger This is maintained with the knuckle at 45 degrees the proximal interphalangeal joint at 90 degrees and the distal interphalangeal joint at 45 degrees

Oblique or spiral fractures without displacement are immobilized without traction in slight flexion

Chip fractures of the distal phalanges that enter the joint are of no great importance Treatment is primarily directed toward alleviating the sprain of the joint

If a large portion of the articular surface is broken off the stability of the joint is imperilled and there exists a tendency toward a flexion deformity An example of this type of fracture is the mallet finger in which the end of the digit is struck by an object such as a baseball The distal interphalangeal joint is acutely flexed avulsing the insertion of the terminal slip of the extensor tendon which sometimes carries with it a section of its bony attachment sometimes is avulsed without fracture In either case there is inability to extend the terminal phalanx of the finger

This injury is by no means trivial It may result in permanent deformity unless properly treated

The mallet finger is immobilized for six weeks The position of the finger is that of *flexion* of the proximal interphalangeal joint and *hyperextension* of the distal interphalangeal joint Immobilization is accomplished by a circular plaster of paris bandage The plaster is rolled around the finger *while dry and the finger is then dipped in* water While the plaster is setting the patient maintains the correct position by pressure on the tip of the phalanx with the thumb This is held until the plaster has firmly set Union is usually complete in six weeks

FRACTURES OF THE FEMUR

Fractures of the femur are of grave importance They may occur through the *neck* the *shaft* or in the region of the *condyles* involving the

hand have been padded thoroughly with felt The plaster extends around the entire finger and is continued around the forearm almost to the elbow While the plaster is setting position is maintained by *mild* pressure against the *middle phalanx* and counter pressure over the fracture site



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Scudder The Treatment of Fractures

TABLE 1 9—CLINICAL MANIFESTATIONS AND TREAT TE T CF TRACTURES OF HIPS AND LOWER EXTREMITIES (*Cont d*)

Site	Comments
Potts Fracture	Usually due to sudden twist or strain of muscle in severe in ersion or evers on Foot di placed laterally and posteriorly External malleolus generally fractured at le el higher than internal malleolus Take A P and lateral x rays Reduce under local anesthesia Apply posterior molded plaster bound with muslin bandage and encased in a dressing pr vided by two rolls of 4 inch plaster Elevate leg on pillow Carefully observe circulation for 48 to 72 hours Encourage active motion of toes At end of week incorporate walking iron and change plaster if loosened Immob l ze for ten to twelve weeks Later substitute elast c bandage If union is delayed or impe fect consult orthopedist
Ui d placed Fracture of Single Malleolus	More frequent than Pott s fracture Reduct on unnecessary Immobil ; e leg n plaster of paris boot from toes to belo knee Maintain for six weeks
Cl p Fractures of *Malleolus*	Immob lize with adhesive
Os Cal is	Usually result of fall from height \ tl patie t la ling o l eels Look for associated f acture of spine 1 acture usually exten ls ; to ul ; stragaloid joints Refer to speciali t for I ct on immol lization and tr ple arthrodesis
Tarsus	Rare injury due to indirect olence Mini num I placement R uce Immob lize in plaster
Metatarsals	Ra ely d place l Immobil ze in plaster of p r s boot for four to e ght weeks W th march fractu e of metatarsal try firm adhes e strap] i g or metatarsal suppo t (p 3090)
Toes	Usually of proximal phalanges ith pl nt r angulat on Immob lize l strapp ng Use adjacent toes as splints Ins rt lamb s wool for nterd g tal padding Ma ntain for three to fou eeks

structures of the knee joint In children slipping of the *upper femoral epiphyses* presents a formidable problem

Fractures of the Neck of the Femur—Tracture of the neck of the femur occurs most frequently in elderly people It may be the result of a seemingly trivial injury

While the classical signs of fracture are *external rotation of the limb inability to lift the heel from the bed* and *shortening of the affected extremity* fracture may be present in the absence of all of these manifestations With an impacted fracture the patient may be able to bear weight

The only safe method of dealing with a suspected fracture of the neck of the femur is insistence upon a roentgenographic examination This should be done to any elderly individual who complains of hip pain following any type of trauma no matter how inconsequential

The *treatment* of fractures of the hip should be delegated to the

TABLE 159—CLINICAL MANIFESTATIONS AND TREATMENT OF FRACTURES OF HIPS AND LOWER EXTREMITIES

Most fractures of the lower extremities involve neck of femur or lower end of tibia and fibula (Potts) The first of these requires specialist consultation since the injury holds serious threat The Potts fracture however is distinctly within the province of the practitioner who may obtain a most satisfactory result if ordinary cautions are observed

Site	Comments
Neck of Femur	Most frequent in elderly Note external rotation of limb inability to lift heel from bed and shortening of affected extremity Insist upon x rays Obtain specialist consultation for internal fixation as soon as evidences of forward failure have been controlled Prevent complications such as hypostatic pneumonitis urinary retention impaction of feces psychoses and phlebitis by early convalescence Local hazards include aseptic necrosis of head and non union requiring specialist consultation
Upper Femoral Epiphysis	At time of puberty in children of Frohlich type Often bilateral Epiphysis slips backward on neck of femur Best observed on lateral x ray Later downward displacement visible on anteroposterior films Limitation of motion first noted in internal rotation with child on abdomen and knee flexed to 90 Refer to specialist for immobilization with or without traction and with or without fixation with stainless steel wire or Smith Petersen nail
Shaft of Femur	Usually compounded and accompanied by considerable forward failure Use Thomas splint for first aid immobilization Refer to specialist for treatment using Russell traction in Balkan frame Union requires three months or more Open reduction and internal fixation may be required
Lower End of Femur	Pull of gastrocnemius usually causes angulation of fragment with convexity toward flexor surface Specialist consultation required for open reduction
Patella	Usually transverse tear with separation of lateral expansions of quadriceps tendon Refer to specialist for open reduction and wire suture Immobilize in extension for several weeks
Tibial Condyles	*Usually bumper fracture with tear of ligaments of opposite side of* knee Without marked displacement immobilize in extension for six weeks Aspirate extensive hemarthrosis before application of plaster With marked displacement consult orthopedist for possible open reduction
Tibial Spine	Usually associated with injury to cruciate ligament. Consult orthopedist for prolonged immobilization or open reduction
Shaft of Fibula	If present as isolated lesion immobilize by short leg plaster
Shaft of Tibia	May or may not be associated with fracture of fibula If transverse linear or incomplete maintain by immobilization in plaster If oblique or comminuted refer to specialist for traction usually provided through wire threaded through os calcis Immobilize for three or four months Check with frequent radiographs

is largely cancellous Careful radiographs are required to demonstrate the line of fracture

Intertrochanteric fractures may be treated conservatively by *immobilization* in traction The object of therapy is the prevention of deformity as well as the production of union The pull of the muscles that extend from the pelvis to the lower extremity causes the hip to assume a deformity of the coxa vara type There is consequent shortening and abductor weakness producing a permanent limp

With conservative treatment by traction the coxa vara deformity must be corrected Traction is continued for a period of eight to twelve weeks Weight bearing cannot be permitted until firm union is demonstrable by radiograph



Fig 846—Separation of the upper epiphysis of the femur Note epiphysis separated and displaced so as to rotate the femur inward corresponding to the photograph of the attitude of this patient (Fig 848) Absence of the lesser trochanter demonstrates the rotation of femur inward (Mumford) (Fig 847)

The high incidence of complications such as hypostatic pneumonia resulting from immobilization has resulted in the increasing popularity of surgical treatment by internal fixation

Complications of Fractures of the Neck of the Femur—The dreaded complications associated with fracture of the neck of the femur are local and systemic

The immediate systemic danger is that of *shock* More commonly systemic complications occur later In the course of prolonged immobilization the patient may become *demoralized* particularly if large doses of narcotic are required to allay pain *Hypostatic pneumonia* produces the largest number of fatalities Elderly men are prone to develop *retention of urine* Repeated catheterization eventually leads to infection *Impacted feces* is commonly encountered *Pressure sores* occur under the plaster and

specialist The factors which predispose to the injury such as senility may lead to a fatal termination as the result of the prolonged immobilization

Fractures of the neck of the femur may be *intracapsular* or *extra capsular* The intracapsular fracture extends through the neck with at least part of the line of fracture extending into the joint These fractures may be impacted generally in a position of valgus The proximal fragment is pressed down on top of the fractured neck in such manner that the fracture line is transverse Weight bearing tends to impact the fracture more securely See Fig 843 p 3000

Internal fixation of fractures of the neck of the femur is accomplished by a variety of devices The nailing can be done at any time within

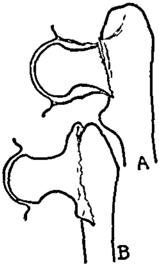


Fig 845—Base of the neck and intertrochanteric fractures Outward rotation up ard riding and coxa vara are the characteristic deformities It will be noted that there is but little rotatory displacement of the head It is practically all abduction The proximal and distal fragments maintain some connection through the fibers of the capsule in *A* the base of the neck, and through the muscle attachments in *B* the intertrochanteric The lesser trochanter may be split off as a separate fragment, and is then pulled upward and medially by the psoas The greater trochanter may in part be a separate fragment Such displacements of the trochanters as exist are of little or no significance They are adequately cared for by flexion of the hip during treatment *

several weeks of the fracture Preferentially it should be done as soon as the primary symptoms of shock have disappeared The procedure is specialized and must be performed by an expert under radiographic control Wiring may be performed under local anesthesia The procedure is accompanied by very little shock

Following internal fixation the patient is infinitely more comfortable and may be permitted to use the extremity for partial weight bearing at the end of three to four months Full weight bearing should not be allowed for at least six months

In the *intertrochanteric fracture* the break extends through the greater and lesser trochanters of the femur usually in the region where the bone

* Murray in Christopher A Textbook of Surgery

over dependent areas *Phlebitis* is commonly encountered *Senile psychoses* are prone to develop and add to the nursing difficulty Many patients without definite and tangible localizing complications become progressively weaker and die of *inanition*

The *local complication* most to be feared is *nonunion* This is rare in the intertrochanteric variety but is more frequently encountered in intracapsular fractures The blood supply to the head of the femur may be impaired by the fracture so that the head may undergo an *aseptic necrosis* This is recognized on the radiograph by an increase in the density of the head usually first seen in the second month after the fracture With aseptic necrosis of the head there is severe pain and disability Secondary *osteo-arthritic* changes result in almost constant pain and discomfort

Slipping of the Upper Femoral Epiphysis—Fracture of the neck of the femur is an injury of the elderly patient Slipping of the upper femoral epiphysis is a condition which is limited to the adolescent group generally occurring at about the time of puberty

A *predisposition* to slipping epiphysis occurs in children of the *Frohlich type* (p 1166) In approximately 25 per cent of instances both hips are involved in the process Since there is rarely a definite history of trauma it is most likely that the predisposing factor derives from endocrinopathy

The slipping may occur gradually or suddenly Usually even in the sudden cases there is a previous history of pain and discomfort referable to the affected hip suggesting that the initiating trauma acted upon an already damaged joint

The epiphysis may slip suddenly after comparatively trivial trauma It *separates from the neck giving the signs and symptoms which accompany* fracture of the neck of the femur

The epiphysis first *slips backward* upon the neck of the femur In the earlier stages the slipping is not recognized on the anteroposterior radiograph though a lateral view clearly shows the lesion Later downward displacement *of the head on the neck is visible on the anteroposterior* radiograph

The appearance of pain in the hip disability or limp in an obese child at the age of puberty requires investigation by a lateral radiograph

Because of the backward slipping of the epiphysis the limitation of motion is first noted in *internal rotation* This is best tested by placing the child on his abdomen The knee is flexed to 90 degrees and used as a lever to estimate the degree of rotation that is possible in the hip

The *treatment* of slipping femoral epiphysis is the province of the specialist Usually conservative reduction and prolonged immobilization with or without traction is sufficient Fixation with the stainless steel wires or the Smith Petersen nail may be necessary Because of the frequency of bilateral involvement the opposite epiphysis must be carefully observed throughout the period of treatment

Fractures of the Shaft of the Femur—Fractures of the shaft of the largest bone in the body are often accompanied by considerable shock They are not infrequently compounded The automobile accident is the most common cause of fracture of the femur Often the patient is seen while still at the scene of the accident For first aid immobilization the ideal method is the use of the Thomas splint



I ıg 847 Separation of the upper epiphysis of the femur After reduction by traction Note that the femoral epiphysis is in its normal place *



Fig 848—Separation of the upper femoral epiphysis in a child (Figs 846 847) Note the deformity as that of a dislocation of the hip on the dorsum of the ilium flexed and adducted thigh flexed knee

* Scudder The Treatment of Fractures

FRACTURES IN THE VICINITY OF THE KNEE JOINT

Fractures of the knee joint may involve the lower end of the *femur* the *patella* the *tibial condyles* or the *tibial spine*

Fractures of the Lower End of the Femur.—Fractures of the lower end of the shaft of the femur may prove difficult of reduction The usual deformity is an angulation with the convexity toward the flexor surface caused by the pull of the gastrocnemius

The specialist orthopedist should be consulted

Comminuted fractures of the lower end of the femur involving the condyles may disturb the articular alignment of the knee joint and require accurate open reduction

Fractures of the Patella.—The patella is a large sesamoid bone which develops in the tendon of the quadriceps muscle

Fractures of the patella are usually caused by *indirect violence* The quadriceps suddenly contracts against unexpected resistance The patella

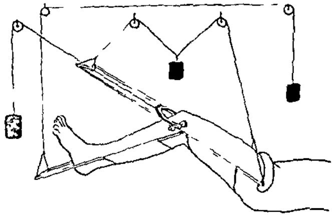


Fig 680—Skeletal traction for fracture of shaft of femur Corks are placed over the projecting ends of the wire a piece of felt fills the space between the yoke and the skin to prevent sliding of the wire and the knee is mobilized with the counterbalancing weight within reach of the patient's hand

is transversely fractured and the lateral expansions of the quadriceps tendon are torn The two fragments of the patella are widely separated so that gross defect is readily palpable The knee cannot be extended voluntarily

With this type of fracture *open reduction* by a specialist is necessary The lateral expansion of the tendon is carefully sutured The patella is compressed into position by a circumferential silk or wire suture Occasionally when there are comminuted fragments part or even all of the patella must be removed to prevent subsequent osteo arthritis from a badly disorganized joint surface

Fractures of the patella occasionally result from *direct violence* such as a sudden blow against the dashboard of an automobile This type of fracture is generally stellate The lateral expansions of the patella ligament are intact The patella is bound about by strong undamaged fibrous tendons so that the fragments are not displaced

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The *diagnosis* of fracture of the shaft rarely presents difficulty Ther is often an obvious deformity a great deal of pain and a rapid develop ment of a hematoma

The shock and gravity of shaft fractures usually demand hospitaliza tion The patient should be splinted during transportation Adequate dose of morphine are administered Wherever possible the specialist orthope dist is summoned

A common method of *treatment* of fractured femur is by *Russell trac tion* in a *Balkan frame* The alignment of the fragment is carefully checke by repeated radiographs taken at short intervals for the first week or tw of treatment

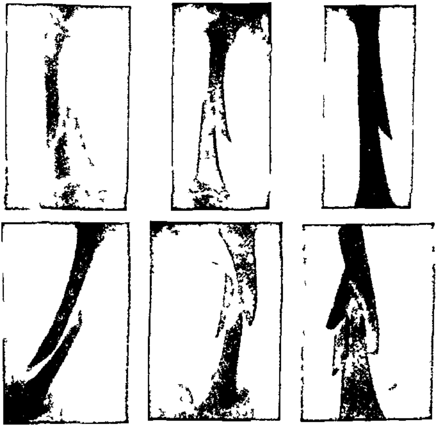


Fig 849—Fracture of the shaft of the femur Types of fracture

In the adult *union* generally requires three months or longer If it is impossible to hold the fragment by simple traction *skeletal traction* in the form of a wire through the tibial tubercle is employed *Open reduction* and *internal fixation* may be required

In infants traction (Bryant) in a vertical direction may be applied to both legs with knees straight and hips flexed Adhesive skin traction is usually sufficient Union may be firm in six weeks Exact reduction is not necessary in children Side to side apposition may be accepted pro vided the alignment is good

Scudder The Treatment of Fractures

Fractures of the Shaft of the Fibula—Isolated fractures of the shaft of the fibula are comparatively trivial injuries They will heal satisfactorily with immobilization by a short leg plaster or a firm adhesive strapping Weight bearing need not necessarily be interrupted

If there is an overriding of the fibular fragment it is likely that there is also a fracture of the tibia at a higher or lower level This should receive first consideration since the fibular deformity will probably be corrected with the alignment of the more important bony structure

Fractures of the Shaft of the Tibia With or Without Fibular Break—In fractures of the shaft of the tibia with or without a break in the fibula attention should be focused on the disturbance of the shin bone The fibular shaft bears *no weight* It is of importance in its upper and middle part principally as an organ for muscle attachment Alignment of the tibial fragment results in adequate correction of the fibular lesion



Fig 85 —Closed comminuted fracture of both bones of the leg (Griswold)

The shaft of the tibia is usually broken as the result of *direct violence* Because of its subcutaneous position these fractures are often compound

Fractures of the shaft of the tibia may be transverse or oblique In the transverse linear or incomplete type of fracture of the tibial shaft reduction is maintained by immobilization in plaster without the addition of traction

With oblique and comminuted fractures traction always is necessary because *of the tendency of the fragments to override as the result of the* powerful action of the calf muscles Wherever possible the oblique comminuted fracture should be referred to the specialist It may be necessary to provide traction through a wire threaded through the os calcis

Tibial fractures usually require three months or longer for union Immobilization is continued until union is demonstrable by radiograph

Treatment of this type of patella fracture is splinting in extension for four to six weeks The bandage is applied from the toes to the groin Weight bearing may be permitted

A third type of patella fracture is the longitudinal fracture This is usually unrecognized The patient complains of prolonged pain and disability of the knee Simple plaster immobilization for four to six weeks is indicated

Fracture of the Tibial Condyles—Fracture of the tibial condyles is usually caused by lateral pressure applied to the side of the knee joint This *type of injury may result from a blow* on the outer side of the knee by an *automobile bumper* Such an injury produces a tear of the ligaments of the opposite side of the knee (tear of the internal lateral ligament from a blow on the outer side of the knee joint) If the ligament holds the femoral condyle may be driven forcibly into the lateral tibial condyle producing a fracture of this cancellous bone

The *treatment* of fracture of the tibial condyle without marked displacement consists in immobilization with the knee in extension for six

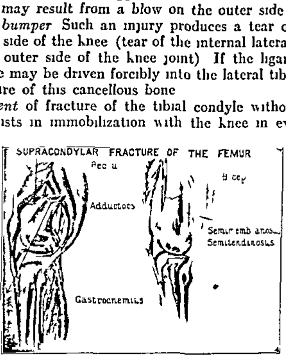


Fig 851—Supracondylar fracture of the femur Note displacement and perfect reposition (Henderson)

weeks During the latter part of this time weight bearing is permitted If there is an extensive hemarthrosis aspiration of the extravasated blood may be advisable before the application of the plaster

If there is considerable displacement causing lateral instability of the joint the specialist orthopedist should be consulted since it may be necessary to perform an open reduction

Fractures of the Tibial Spine—Fractures of the tibial spine are caused by indirect violence The cruciate ligament attached at this point may avulse a fragment of bone when subjected to excessive strain

If reduction cannot readily be accomplished by closed manipulation the specialist should be summoned Immobilization should be continued for at least six weeks

FRACTURES OF THE SHAFT OF THE TIBIA AND FIBULA

Fractures of the shaft of the leg bones may involve the fibula alone or the tibia and fibula

There is no need to maintain the foot in inversion Great care is taken to avoid pressure over bony prominences

The plaster dressing is checked by radiograph The following findings show that the reduction is completed the deformity is absent the malleoli are normally realined pushing up on the foot does not reproduce the deformity and x ray examination in three axes is satisfactory The patient is then put to bed and the leg elevated on a pillow The circulation is

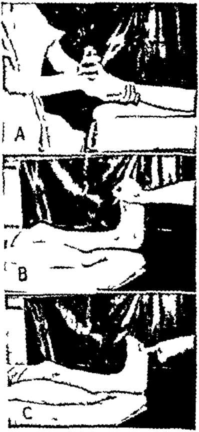


Fig 854—Steps in reduction of Potts fracture *A* Flexion and inversion *B* hyperflexion *C* Jones's test for reduction i e pressure of one finger usually is the necessary flexion and inversion knee flexion is an aid in most cases

carefully watched for the first two or three days In the event of any circulatory embarrassment, the cast must be slit longitudinally over the anterior surface All materials are removed down to the skin

From the beginning of immobilization the toes are actively moved At the end of several days the patient may become ambulatory using a crutch At the end of a week or less if the plaster is snug a walking iron may be incorporated and the patient encouraged to begin weight bearing

Moorhead Clinical Traumatic Surgery

FRACTURES ABOUT THE ANKLE JOINT

In the region of the ankle joint the commonest break is *Pott's fracture* which involves both external and internal malleoli Occasionally there is an accompanying break of the posterior portion of the articular surface of the tibia (*trimalleolar fracture*)

Pott's Fracture —Pott's fracture is usually due to a sudden twist or strain of the ankle caused by severe inversion or eversion

Characteristically Pott's fracture discloses a foot which is displaced laterally and posteriorly There is marked tenderness over the site of the fractures of the malleoli The external malleolus (of the fibula) is generally fractured at a higher level than the internal malleolus (of the tibia) The fracture line is usually oblique in the lower quarter of the fibula

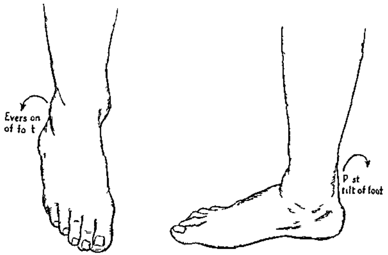


Fig 853 —Outward and backward displacement of foot in Pott's fracture

Radiographs of the ankle joint are taken in anteroposterior and lateral views The fracture of the tibial articular surface may be visible only on the latter This view gives an estimation of the degree of posterior displacement of the foot

Reduction of the Pott's fracture can be accomplished under local anesthesia One injection of 20 cc of 2 per cent procaine is sufficient to anesthetize the fractures which usually both communicate with the ankle joint

After satisfactory anesthesia has been obtained the foot is replaced in the mortise formed by the lower ends of the tibia and fibula which fits into the articular surface of the astragalus A posterior molded plaster splint is applied A muslin bandage is used to bind over the splint The whole dressing is encased in a dressing provided by two rolls of 4 inch plaster of paris The latter is rapidly applied avoiding wrinkling and the plaster is molded while still wet

* Moorhead Clinical Traumatic Surgery

It is usually sufficient to immobilize the leg in a plaster of paris boot extending from the toes to below the knee This is maintained for a period of six weeks

If there is displacement of the foot despite the fact that one malleolus is intact it is likely that there has been a rupture of the ligament binding the intact malleolus to the foot This type of injury is treated as the bimalleolar fracture

Rupture of the lower tibiofibular ligament results in a spread of the joint mortise This type of injury requires reduction with mild lateral compression Healing usually occurs without residuals

Chip fractures of either malleolus are extremely common They are really avulsion breaks caused by a tearing away of a fragment of bone as the result of strain through the corresponding ligamentous attachment The chip fractures are treated as sprains of the ankle (p 2977)

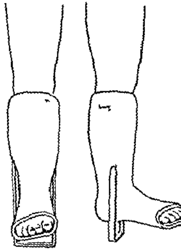


Fig 857—Walking plaster for uncomplicated malleolar ankle fractures Must be molded accurately about tibial condyles must be adequately padded to protect peroneal nerve in region of the fibula neck and should have thick padding between sole of foot and bottom of plaster boot to prevent direct pressure upward on ankle Weight is actually borne on tibial condyles Iron stirrup is incorporated in upper half of plaster

Injury to the lower tibial epiphysis resembles similar trauma to the lower radial epiphysis These juxta articular fractures are easy to reduce

Should the epiphysis be markedly traumatized growth may be disturbed or may actually cease resulting in a varus or valgus deformity of the foot The latter is an indication for osteotomy which should not be deferred until full growth has been attained even though the procedure must be repeated

Complications of Ankle Fractures—The most frequent complication of fracture in the region of the ankle joint is *malunion* Weight bearing produces *pain* and eventually an *osteo arthritis*

When this situation arises the specialist orthopedist is consulted *Osteotomy* to realign joint surfaces may suffice unless there has been marked

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The plaster is changed at intervals as soon as it becomes loosened At each reapplication radiographs are made to check the progress of the lesion

Immobilization is continued for ten to twelve weeks When callus is demonstrable an elastic bandage may be substituted The patient should be encouraged to walk as much as possible Exercises for the development of the arch muscles (p 3760) are taught If necessary, supports are placed in the shoe

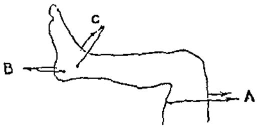


Fig 855—Reduction of ankle fractures with displacement of both malleoli with disruption of the mortise or with posterior marginal fractures Knee flexion is essential (A) represents countertraction force (B) represents downward traction on heel (C) represents compressive force to replace talus and malleoli and to correct disruption of the mortise Whether the correction is done manually or by apparatus these three forces have to be employed

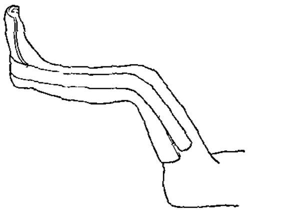


Fig 856—Immobilization for ankle fractures requiring reduction (Described in Fig 855) Essential points are snug fixation bilaterally and posteriorly at the ankle with foot at right angles and in slight inversion and lateral and posterior fixation of the knee to prevent extension or rotation The splinting must extend as close to the groin as possible Circular plaster properly applied is just as acceptable as molded splints

If more than a considerable fragment of the posterior articular surface of the tibia has been broken the reduction of the posterior displacement of the foot is unstable Redisplacement occurs because of the absence of the posterior tibial lip Under these circumstances the specialist is consulted If more than a third or half of the articular surface has been broken off open reduction and internal fixation of the fragment may be necessary

Undisplaced fractures of a single malleolus occur even more frequently than Pott s fracture Under these circumstances reduction is unnecessary

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or *firm adhesive strapping* employed for six weeks gives excellent results although nonunion may occur When this results no treatment is generally necessary though either a bone graft or removal of the fragment may be necessary to alleviate persistent pain

The so called *march fracture* of the metatarsals is thought to be produced by severe exertion such as long march over rough terrain while carrying heavy loads It is most often seen in soldiers

There is marked pain in the foot Physical examination may show no abnormality Radiographs at first may also be normal After several days or weeks a fine line of fracture becomes visible emphasized by the surrounding callus formation

A *walking plaster boot* is applied until union is demonstrable

Fractures of the Toes—Fractures of the *proximal phalanges of the toes* are usually displaced with an angulation plantarwards

Treatment of fractures of the lateral four toes is usually restricted to immobilization by strapping the affected toe to its adjacent members using them as a splint Lambs wool makes a very comfortable interdigital padding Reduction is generally not necessary except in the first toe where function may be disturbed if gross deformity is allowed to persist Immobilization should be continued until symptoms have disappeared—usually from three to four weeks Weight bearing with a cut out shoe is generally possible at once

The big toe should not be strapped to its neighbor for immobilization but should rather be supported by a dorsal splint made of molded metal plaster or several applicator sticks between layers of adhesive Reduction if necessary can be done under procaine anesthesia Pulp traction may be necessary

Fractures of the *distal phalanges* are generally undisplaced They result from direct violence such as stubbing or dropping heavy objects upon the toes It is sufficient to protect the site by a circular adhesive strapping

arthritic change Under these circumstances an *arthrodesis* is indicated This is an extremely satisfactory operation It is accompanied by little handicap since the midtarsal and *subastragaloid joints develop compensatory motion*

Nonunion of isolated malleolar fractures without displacement of the foot usually causes no difficulty The resulting fibrous union is generally quite satisfactory

FRACTURES OF THE FOOT

Fractures of the foot commonly involve the os calcis the tarsal or metatarsal bones or the toes

Fractures of the Os Calcis —Fracture of the os calcis usually results from direct violence The mechanism is a fall from a considerable height the victim landing on his heels There may be an associated fracture of the spine (p 3004) The possible coexistence of these fractures should be investigated

The os calcis is composed of spongy or cancellous bone The squashing fracture causes a compression in the vertical diameter and a bulging laterally The normal angle of the heel is lost The fracture usually extends into and disrupts the subastragaloid joint This results in constant pain and permanent disability

The management of a fracture of the os calcis is truly the province of the specialist The tuber angle of the os calcis may be restored by traction carried out by means of a wire introduced through the heel with counter *traction through a wire or pin in the tibia Lateral bulging is corrected* by compression with a special clamp When there are persistent symptoms due to involvement of the subastragaloid joint triple arthrodesis (of the subastragaloid and midtarsal joints) must be done The routine which should be followed is (*1*) reduction (*2*) immobilization for six weeks and (*3*) triple arthrodesis if pain persists

The rare fracture of the os calcis which is limited to the region of the bone behind the articulation for the talus is usually undisplaced unless there is deformity due to the pull of the calf muscles This should be re aligned and immobilized These fractures offer an excellent prognosis They are to be treated by simple immobilization

Fractures of the Tarsal Bones —Fractures of the tarsal bones are rare They usually result from indirect violence Displacement is generally minimal unless they are associated with a dislocation of the subastragaloid joint

Reduction and *immobilization* in plaster should be maintained until the radiograph demonstrates union

The late complications of these fractures are *aseptic necrosis* and *traumatic arthritis* Both conditions require special handling *i e* a fusion of the affected bone or joints

Fractures of the Metatarsal Bones —The metatarsal bones are quite often the site of fracture resulting from direct or indirect violence There is rarely any displacement *It is sufficient to immobilize the foot in a plaster* of paris boot for from four to eight weeks

Fracture of the *base of the fifth metatarsal* commonly results from an inversion strain of the foot This results from the pull of the peroneus brevis tendon There is usually no displacement A *walking plaster boot*

to walk on his hind legs illustrates the manner of this evolution He extends his hips to the utmost but cannot get them to parallel his spine To compensate for this he arches his back and extends his spine in the lumbar region Man has evolved by a similar mechanism and while he has brought his hips to extend beyond the right angle he still requires a normal lumbar lordosis This necessity produces considerable strain on the lumbosacral joint for it is at this point that the spine and its superincumbent weight rest upon the oblique first sacral vertebra Postural defects produce a strain of this inherently weak mechanical structure and hence low back complaints are the expectancy of Everyman and his wife

The mechanics of the evolution of the erect posture explain not only the frequency of low back complaints but also indicate the manner of their correction An improved mechanical arrangement is provided by rotation of the pelvis so that its obliquity is less pronounced When this is accomplished in the erect posture the buttocks are flattened the hips are more fully extended and the lumbar spine with its superincumbent weight rests upon a more nearly horizontal first sacral vertebra This is the essence of *good posture* and the fundamental objective in all *corrective exercises* (p 3757)

Development of the Anteroposterior Spinal Curves—In utero and shortly after birth the spine forms one continuous curve with its convexity situated dorsally As soon as the child begins to hold up its head a *cervical lordosis* is produced and persists throughout life When the child begins to walk and assumes the upright posture the *lumbar lordosis* develops To compensate for these physiologic curvatures the *dorsal and sacrococcygeal portions* of the spine continue their dorsally convexed curves (*kyphosis*) throughout life

GOOD POSTURE

Good posture in the upright sitting and recumbent positions is described with the routine physical examination (p 3492) The reader is urged to review this information before proceeding further with the present material

BAD POSTURE

Bad posture is virtually a universal finding It is illustrated in the standing sitting and recumbent positions

With poor and bad *standing posture* the head hangs forward producing an increase in the dorsal kyphosis and a flattening of the chest The breast bone occupies a position on a plane posterior to the head and chin The malposition of the chest and dorsal spine is compensated by an increased lumbar lordosis and a sharp lumbar angulation There results a protuberance of the lower abdomen hyperextension of the knees and eversion of the foot so that the weight bearing line falls medial to the arch which will sooner or later weaken and fall causing all manner of difficulty in the pedal extremities

Poor posture is epitomized in the debutante slouch affected by fashionable women of the linear type Their silhouette is characterized by the wings of the scapulas rather than any suggestion of normal mammary tissue In the stocky female the postural changes are exaggerated by the pendulousness of the breast and the fullness of the buttock In the obese

CHAPTER 140

THE SKELETAL AND LOCOMOTOR SYSTEMS POSTURAL STRAINS, DERANGEMENTS AND DEFORMITIES HERNIA

- Evolution of the Erect Posture
- Good Posture
- Bad Posture
- Postural Strains
- Scoliosis
- Kyphosis
- Lordosis
- Postural Strains of the Back
  - Acute Low Back Sprain
  - Chronic Postural Back Strain
- Deformities and Static Disturbances of the Foot
  - The Normal Foot
  - Abnormalities of the Foot
    - The Weak Foot
    - Morton s Metatarsalgia
    - Clawfoot
    - Hallux Rigidus
    - Hammer Toe
    - Overlapping Toes
    - Corns (Clavus)
    - Plantar Wart
    - Painful Heel
    - Short Heel Cord
- Hernia

The structure of the human body suggests that man like other mammals was at one time intended to walk on his four extremities The higher apes assumed the upright posture but continued to aid their legs in locomotion by the free use of their long arms Man has carried this evolutionary process further to walk erect on his two feet The adaptation of the human skeleton apparently has not yet kept pace with human aspiration As a result the assumption and maintenance of the erect posture is accomplished at great mechanical strain Painful afflictions of the back and lower extremities are almost universal in their occurrence These disturbances cannot be understood or correctly treated unless the nature of their production is clearly understood

EVOLUTION OF THE ERECT POSTURE

Our ancestors walked on all fours The trunk was supported by an extremity at each corner The spine was propped at both ends and the internal organs were suspended by their mesenteries so that they strung out like clothes on a washline The hip and shoulder joints were normally flexed to right angles with the spine

The assumption of the upright attitude required a combination of extension at the hip joint and extension of the spine The dog who attempt

Most skeletal pain and discomfort including neck pain shoulder pain lower back pain discomfort in the thighs and calves as well as the mechanical foot troubles result from a faulty standing sitting or reclining posture Much information concerning the mechanics of the foot can be obtained from simple observation Cramped overlapping toes calluses bunions and unevenly worn soles and heels are unimpeachable evidences of faulty foot mechanics The attentive practitioner will at a glance observe the *posture of the patient* Before ordering radiographs blood chemical examinations tooth and tonsil extraction he will perform the inexpensive therapeutic test of observing the effects of good posture on the presenting symptoms

Postural Abnormalities Associated with Organic Disease —Clinical manifestations *of postural abnormalities are seen in those who are otherwise* structurally normal as well as in patients whose diseased tissues offer a place of least resistance This is illustrated in *rheumatoid arthritis* (p 2910) and *peripheral vascular disease* (p 994) of whatever types Any symptoms that occur in a patient with these organic disturbances are attributed to the major chronic disorder Often the clinical difficulties arise from the postural condition which accompanies or results from the diseased state Attention to body mechanics will certainly not affect the pathologic condition but may relieve the symptoms To the patient this is the prime desideratum

POSTURAL STRAINS

The upright posture is maintained by dint of continuous muscular activity Whereas the four legged animals may sleep standing up man requires a more or less conscious muscular regulation of his body position He has a relatively high center of gravity superimposed on a small base support and the mechanics of bad posture only add to the muscular and ligamentous strains producing increasing distortions

The attitudes in faulty posture are due to relaxation of muscular control The additional burden in the maintenance of bad posture is shifted to the bones joints and ligaments The spine exhibits an exaggeration of its normal anteroposterior curves There is an increase in the cervical lordosis the dorsal kyphosis and the lumbar lordosis Sooner or later the malformations produce lateral curvature (scoliosis) and/or low back pain

Slovenly posture does not stop with disturbances of the back but involves all of the joints from the foot to the base of the occiput An attempt is made to compensate by altering the mechanics of the foot *Weight bearing is transferred to the heels and the feet evert penguin like* The weight bearing line falls over the internal malleolus instead of through the center of the metatarsal arch The knees knock and the arches fall or are strained but the patient insists that he has rheumatism or lumbago

Sooner or later the postural strains produce organic manifestations Evidences of a *fibromyositis* (p 2894) are apparent in the powerful posterior spinal muscles from the occiput (indurative headache p 1512) to the sacrococcygeal region (lumbago sacro iliac sprain) Thickenings due to *osteo arthrosis* (p 2855) are observed radiographically in the spine hips and knees and *periarticular effusions* develop especially in the knees and the joints of the feet

the abdominal and lumbar lordotic changes are increased by the panniculus While the slouch is more common the overly erect posture affected by the military man and the militant woman may also give rise to mechanical difficulties Various postural abnormalities are usually cumulative the one leading inevitably to the other

Bad sitting posture consists in slouching in a soft chair legs crossed buttocks at the edge of the seat only the shoulders impinging upon the back of the chair In the instance of an office worker the individual crosses the legs or winds them around the legs or rungs of the chair He alternates



Fig 858—Posture *A* Poor posture as seen on first examination *B* immediate improvement with the application of the sandbag *C* Balinese woman photograph by Malvina Hoffman *

between exceedingly erect posture with an increase in both lumbar and dorsal curves and a relatively collapsed posture the whole back being rounded the elbows or arms resting on the desk or table

The common *faulty recumbent posture* is that of lying on a sofa or bed the head propped on several pillows so that the chest is collapsed the mattress beaten into a trough Skeletal and particularly *back pain* which is worse on arising each morning is most suspicious of a faulty sleeping posture probably resulting from a worn soft mattress or a sagging spring

* Courtesy of Field Museum of Natural History

tioner sans tonsils sans appendix sans bank book retaining only the pristine complaints

SCOLIOSIS

Scoliosis the lateral curvature of the spine is always accompanied by a rotary component The disturbance may be functional or organic in its origin

FUNCTIONAL SCOLIOSIS

The functional scoliosis represents an *habitual defect in posture* There is no fixation of the curve it can be corrected voluntarily and passively More than 95 per cent of all of the functional scolioses are *left total curves* meaning that the convexity of the curve is to the left and there is only a single curve throughout the entire spine The left shoulder is higher than

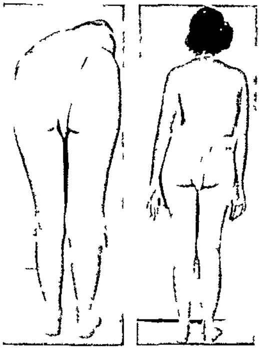


Fig 8 9—Congenital scoliosis

the right By tilting the thorax toward the left the curve can be over corrected It also disappears completely in recumbency

The *treatment* of functional scoliosis is best left to the orthopedic specialist The prognosis is excellent and the fundamental aim is the correction of the postural disturbance by *exercises* as indicated (p 3757) Occasionally if there is a difference in the length of the legs a correction by the use of a *lift* in the *shoe* (p 3081) may be all that is required

STRUCTURAL SCOLIOSIS (FIXED OR ROTARY LATERAL SCOLIOSIS)

Structural scoliosis is a fixed lateral curvature of the spine that is accompanied by deformity of vertebrae Its treatment constitutes one of the most difficult problems of orthopedic surgery

Visceral Manifestations of Faulty Posture—The viscera probably suffer from faulty posture as much as the skeletal structures The manifestations are more subtle and less clearly recognized

With poor posture the thoracic cage is held in an attitude of forced expiration with a consequent diminution in *vital capacity* The limitation of chest expansion is particularly noted in rheumatoid arthritis (p 2910) The diminished expansion of the lungs produces a decrease in the return flow to the right heart since there is a loss of the normal pump action of the abnormally compressed vena cava These changes emphasize the importance of the *breathing exercises* so often recommended and so rarely carried out

The intrathoracic changes are referred to the abdomen since the diaphragm is forced down and the abdominal cavity is compressed The anterior abdominal muscles sag the belly protrudes and *herniation* is invited Faulty posture is usually reflected most notably in the gastro intestinal tract the urinary and female reproductive systems The greater curvature of the *stomach* rests on the pelvic brim The *duodenum* is elongated and the *duodenojejunal angle* becomes acute inviting a delay at this point and producing the otherwise obscure syndrome of *duodenal ileus* The loops of the *small bowel* jam into the pelvis or pouch out in the pot belly The *cecum* descends into the pelvis The *transverse colon* held at either end by the hepatic and splenic attachments swings down like a hammock and the patient complains of indigestion anorexia biliousness auto intoxication constipation colitis and general misery The *kidneys* particularly the right become ptosed and movable Angulation at the ureteropelvic junction causes an *acute hydronephrosis* (Dietl s crisis) Women have a retroversion and retrocession of the uterus leading to *dysmenorrhea* and *sterility* The male has a *varicocele* and *testalgia*

Treatment—There is only one successful method of treating faulty posture and its consequences *Corrective exercises* (p 3757) must be instituted and carried out faithfully and conscientiously over a long period of time The patient must become posture conscious and observe his body mechanics when walking sitting and reclining

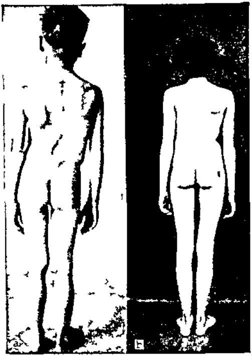
The adjuvants to postural training require the choice of *correct shoes* (p 3081) firm well built *chairs* and a *firm mattress* Old patients and those who cannot or will not cooperate for one reason or another require proper *corseting* and the prescription of *braces supports* and *girdles*

It is an unfortunate truth that few patients properly cooperate with the routine designed to correct faulty posture Rather they prefer to take rheumatism cures packs massage electrical treatments adjustments manipulations injections of vaccine vitamin pills faddist s diets or mud packs They swallow large quantities of analgesic drugs and suffer tooth extraction tonsillectomy herniotomy operations for the correction of the malpositions of the uterus nephropexies gastropexies colopexies and appendectomies for chronic appendicitis When these ministrations fail the inevitable *anxiety neurosis* (p 1347) is superimposed since the afflicted individual not without reason believes that he suffers from an incurable disease most likely a *carcinomatosis* Then like Peer Gynt who traveled the world seeking for love which he found in his own home where he had left it the postural wreck' returns from the miracle men to his practi

shift of the trunk causes one hip to appear prominent One extremity may be shortened

The best estimate of the degree of the deformity is afforded by *radiographs* These also give a clue as to the fundamental pathology

Treatment —The essential keynote of the treatment of structural scoliosis is the knowledge that the lesion usually ceases to progress when growth stops at the age of approximately 16 in girls and 17 in boys The early case is assessed by means of an anteroposterior roentgenogram of the spine taken in the standing position The decision as to the type of treatment depends on the amount of progression noted on subsequent serial roentgenograms If there is rapid collapse and progression of the


Fig 860 —*a* Paralytic scoliosis *b* habitual scoliosis

curve a surgical correction by means of a *turnbuckle* (Risser) jacket followed by fusion of the spine when maximum correction is attained is indicated This entire procedure may occupy six to twelve months If progression is slow or absent and the patient has nearly attained full growth treatment by exercises and braces may be sufficient careful check being made from time to time by serial roentgenograms

KYPHOSIS

Kyphosis is an anteroposterior spinal curve with a *dorsal convexity* Normally the dorsal and sacral coccygeal spinal segments present a kyphotic curve A pathologic increase in this appearance or a kyphosis in some other region of the spine represents a significant change

Steindler in Christopher A Textbook of Surgery

Clinical Manifestations—The scoliosis is described as *right* or *left* according to the side of the convexity The curves may be *simple* or *compound* The simple or total curve has only one curvature while the compound curve is S shaped The *primary curve* is usually the more severe and the more rigid The *secondary curve* is compensatory and may be considered as an attempt on the part of the spine to straighten itself from the bent over position of the primary curve

In the *functional types* of scoliosis the most frequent curve is a total left The more usual type in the *structural scoliosis* is S shaped with a right dorsal left lumbar curve This indicates that the convexity is to the right in the dorsal region and to the left in the lumbar region

Beside the obvious structural deformity the *vertebrae* are deformed and asymmetrical The *paravertebral musculature* and the *soft tissues* are shortened and contractured on the concave side Due to malposition of

DIFFERENTIAL DIAGNOSIS OF

Scoliosis

In most instances of scoliosis the causative mechanism is clearly apparent as a functional or anatomic abnormality In tances of idiopathic curvatures are encountered but they are rare

CAUSES	CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES
Functional	Postural defect Corrected voluntarily or passively
Structural	
Congenital	Hemivertebra demonstrable on lateral x rays
Thoracic	Deformities of chest wall due to thoracotomy or thoracoplasty
Neurogenic	Following muscle atrophy in poliomyelitis or hemiplegia Note motor and sensory abnormalities in neurologic examination
Metabolic	*Vitamin D deficiency causing infantile rickets* or osteomalacia

the joints *motion of the spine is restricted* and *early osteo arthritic changes* are prone to occur The *trunk* is shortened and collapsed in contrast to the normal length of the extremities The *thorax* impinges on the pelvis and the lower ribs may rest on the pelvic brim producing pain The *internal organs* are dislocated and there are frequent functional changes similar to those noted in simple postural defects (p 3058) There may be severe *cardiac insufficiency* probably the result of torsions of the great vessels

Diagnosis—The usual presenting symptom is the *deformity* that has been noted by the child or its mother There is rarely pain or disability in the early stage The examination reveals the extent of the *curves* in the standing and recumbent positions The *rigidity* of the curve is best determined by traction on the head The amount of *rotation* is noted by having the patient bend forward which causes a projection of the thorax or the lumbar region as a result of the rotation of the vertebral column The

LORDOSIS

The lordosis is an anteroposterior spinal curvature with an *anterior convexity* Lordosis is normally present in the cervical and lumbar regions

ACUTE LOW BACK SPRAIN

The acute low back sprain is the most frequent type of postural strain The patient notes a sudden sharp stabbing pain in the lower back Usu ally the onset is associated with a vigorous motion of the trunk or an attempt to lift a heavy object The pain is so severe that it is sometimes

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DIFFERENTIAL DIAGNOSIS OF

Lordosis

Exaggeration of the normal lordosis may accompany or produce low back strains

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Functional	*Postural particularly in obesity and during* latter months of pregnancy Correct by diet, exercise and abdominal support, if necessary From high heel shoes with shortened Achilles tendon.
	Structural
Mechanical	Fracture dislocations. Spondylolisthesis (p 2979) Congenital dislocations of hips.
Neurogenic	After poliomyelitis particularly with weakness of abdominal muscles
Metabolic	In achondroplasia with dwarfism (p 693 Cretinism with low BMR. Note response to thyroid extract. Vitamin D deficiency and infantile rickets. Note response to vitamin D and calcium. Osteo-arthrosis, a metabolic dis turbance usually in obese middle-aged pa tients with hypometabolism. Involvement of spine weight bearing and distal interphalan geal joints X rays show narrowed joint space lipping and spur formation. Normal tempera *ture and sedimentation rate No muscle* atrophy (p 2885) Institute complete ther apeutic routine

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described as witch s blow The patient is unable to straighten up and may attempt to walk in a partially bent over attitude At times the dis comfort is of such severity that the sufferer is unable to rise from his chair or the floor The condition is recurrent and most patients give a history of several previous episodes

Examination reveal that the patient has a markedly *rigid back* with severe *muscle spasm* There may be a shift in the spinal column to one side or the other (*sciatic scoliosis*) The patient moves with great caution and climbs onto the examining table with difficulty The pain sometimes *radiates down the sciatic distribution*

DIFFERENTIAL DIAGNOSIS OF

Kyphosis

Kyphosis may be manifest as a broad convexity or it may take the form of a fairly sharp and localized gibbus The latter is most frequently seen as a result of tuberculous osteomyelitis with destruction of vertebrae and abscess formation (Pott s disease of the spine)

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Functional	Postural Corrected voluntarily
Structural	
Adolescent	Vertebral osteochondritis (Scheuermann) (p 2926) *Note epiphyseal changes by x ray*
Senile	Osteoporosis Marked radiotranslucency of vertebrae (p 2517)
Neurogenic	Following poliomyelitis and muscle atrophy (p 457) *Paralysis agitans* with intention tremor and festination (p 1505)
Thoracic	In emphysematous Note fixation of chest and distant breath sounds
Mechanical	With fracture dislocation In association with rotary lateral scoliosis
Metabolic	
Acromegalic	With *prognathus (p 1156)* Get x rays of sella turcica Examine fundi
Deformities Due to Vitamin D Deficiency	In infantile rickets and adult osteomalacia Note therapeutic effects of calcium and vitamin D
Osteo arthrosis	Metabolic disturbance usually in obese middle-aged patients with hypometabolism Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation Normal temperature and sedimentation rate No muscle atrophy (p 2855) Institute complete therapeutic routine
Osteitis Deformans (Paget s)	With enlarged cranium and bowed tibias (p 2879)
Infectious	
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine
Hematogenous Osteomyelitis	Get blood cultures and x rays
Tuberculous Osteo-arthritis	With gibbus and Pott s abscess (p 2939) Get x rays

Treatment is directed to the fundamental difficulty and usually requires the services of the orthopedic consultant The kyphos of tuberculous disease requires prolonged *immobilization* in *hyperextension*

origin of the gluteus muscles and in the region of the sacroiliac joint The knee and ankle jerks are usually unaffected The only neurologic finding is the *paresthesia* that may be noted over the lateral side of the thigh or leg

Treatment—The treatment of the acute low back sprain requires immediate relief followed by a search in the period of convalescence for the

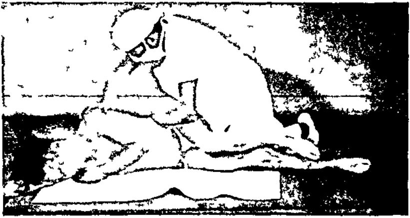


Fig 863—Maneuver 2 Reverse of Maneuver 1 (Extends left sacro iliac joint and stretches anterior sacro iliac ligament also rotates lumbosacral joint in opposite direction to Maneuver 1)



Fig 864—Maneuver 5 Hyperextension of thighs first with the fulcrum on the ilium second with the fulcrum on the sacrum In many cases the fulcrum on the sacrum creates much more pain than when it is on the ilium (Primarily stretches iliotibial bands secondarily rotates sacro iliac joints clockwise on sacrum)

basis of the fundamental disturbing mechanism The immediate procedures for relief include manipulation the injection of procaine strapping bed rest the applications of local heat and the use of analgesics or opiates

Manipulation—It is imperative that the practitioner familiarize himself with the technic of manipulative treatment for the relief of acute back

The Straight Leg Raising Test—With the patient lying on his back the extremity is raised from the table with the knee maintained straight Normally the hip may be flexed to about 90 degrees It is limited in the average individual by a feeling of tension or stretching in the hamstring muscles behind the knee



Fig 861—Demonstrating the deep kneading massage of the gluteal muscles

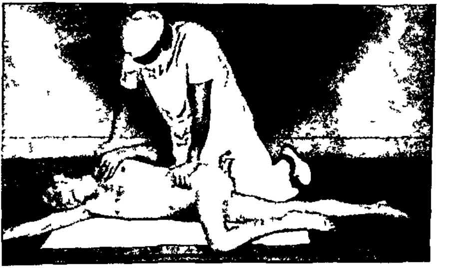


Fig 862—Showing the position for Maneuver 1 of the actual manipulation The ilium is thrust forward and downward the shoulder is rotated backward (Flexes left sacro iliac joint and stretches posterior sacro iliac ligament Some rotary movement to lumbosacral joint) *

The straight leg raising test is markedly positive on one or both sides and palpation reveals a localized *tender point* which is usually just below and lateral to the right or left posterior superior iliac spine Pressure over this point is excruciatingly painful and may produce radiations down the ipsilateral extremity Other sites of pain that are less frequently observed are in the lumbosacral joint in the midline over the

* Barr Modern Medical Therapy in General Practice Williams & Wilkins Company

The patient is then placed on his *right side* The right knee and hip are fully extended while the left knee and hip are flexed The left hand is



Fig 866—Maneuver 8 Hyperextension of spine plus rotation of pelvis first to left and then to right, with spine in *hyperextension* (Lumbosacral maneuver resulting in hyperextension plus rotation of joint) The *legs* are likewise moved from left to right so as to describe an arc in relation to the trunk Has tendency to efface list by mobilizing lower thoracic and lumbar spine in lateral direction



Fig 867—Maneuver 8 Next hyperextension being maintained first one and then the other thigh is dropped, so as also to rotate the pelvis*

placed over the left pectoral *region* The operator then grasps the left ilium with his left hand and holds the left *shoulder* with his right hand.

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sprain The patient lies prone while the operator kneels at his side and massages the gluteal muscles carefully and gently When the musculature relaxes sufficiently deeper kneading over the painful and tender areas is

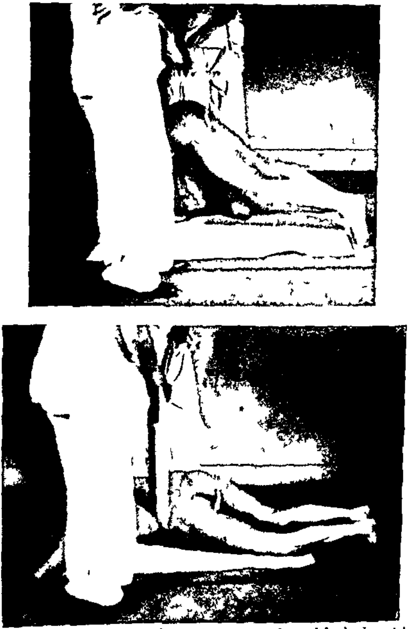


Fig 865—Maneuver 7 Passive flexion of spine at lumbosacral level plus rotation of pelvis with spine in acute flexion (Flexion and rotation of lumbosacral joint stretching of sacrospinalis muscles)*

begun and the process is repeated over the paravertebral and mid thoracic zones

* Barr Modern Medical Therapy in General Practice Williams & Wilkins Company

strict motion in so far as is possible After a preliminary have if necessary the skin is painted with Compound Tincture of Benzoin to afford better adhesion and to protect the surface The patient is stripped while standing in the upright attitude Strips of 3 inch adhesive are applied transversely from a point slightly in front of the anterior axillary line of one side to a corresponding point on the other The widths are overlapped until the back is covered from the region of the lower ribs to the level of the great trochanter The first layers are placed horizontally These are covered with diagonal strips and the final layer is laid on transversely until at least ten widths have been employed Tenuous patching on adhesive invites failure

The strapping should be uncomfortably tight for the first few hours but after this time it affords considerable relief After two to four days the plaster tends to slip It is best reenforced by slitting it longitudinally in the midline and removing a section of 1 to 2 inches in width Two fresh

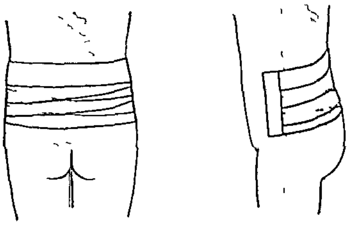


Fig 863—Diagram illustrating the proper application of adhesive strapping to lumbosacral and sacro-iliac regions

layers of transverse adhesive strappings are then applied under tension approximating the cut edges of the original strapping In this way the strapping may be retightened for several weeks without injury to the skin

Bed Rest—Despite any relief that may be afforded by the therapeutic measures previously described the patient should be compelled to *rest the back for several days* If the bed has not a firm mattress several ironing boards or folded bridge tables are placed between the spring and the mattress to prevent sagging The patient is urged to lie on his back using a small pillow under his head and a larger one beneath the knees A hot water bottle is slipped into the hollow of the spine to provide warmth and support Finally the heels are lifted slightly on folded pillows The patient is requested to remain flat for several hours When he attempts to rise he should be assisted by some member of the family He decides which side of the bed seems easier to leave The attendant stands on the chosen side and then bends over while the patient places his outside arm around the

Smith Petersen in Christopher A Textbook of Surgery

With a series of sudden powerful thrusts he then forces the shoulder back ward and the ilium forward and downward

For the *second maneuver* the thrusts are reversed and the shoulder is pushed forward while the ilium is jammed backward and upward

The *third* and *fourth maneuvers* are replicas of the first two except that the patient is on his left side and the pressures are made on his right shoulder and ilium

For the *fifth maneuver* the patient lies prone and the operator bears his weight on his right hand placed over the left gluteus while he hyper extends the left thigh with the knee in full extension The *sixth maneuver* is a repetition of number five using the right side

The *seventh maneuver* requires that the operator take hold of his patient s feet in the fashion of a wheelbarrow The vertebral joints are hyperextended The one leg is dropped and the other maintained in a cycling motion so that the pelvis is rotated

A great number of patients are relieved by these maneuvers whether or not the cessation of symptoms is accompanied by the click suggestive of the reduction of a subluxation of the posterior articular facets (p 2965) When the manipulative treatment is successful there is immediate and dramatic relief and the patient is able to stand up Despite this good for tune the back requires support by strapping rest and the application of heat lest a recurrence be experienced

The exact mechanism by which manipulation is successful is not clear Patients who have had recurrent dislocations and recurrent manipulations are usually relieved by the same maneuver Nevertheless that same mech anism may not be successful in others with apparently similar afflictions There is little doubt that the rapid growth of osteopathy and chiropracty has been due to their extensive and successful use of manipulation in an era when physicians feared to execute these strong arm methods of therapy

Injections of Procaine—Patients with an acute low back disability who manifest one or several well localized points of tenderness (trigger points) particularly over the origin of the gluteal muscles are often phe nomenally relieved when 2 per cent *procaine* (p 3915) is injected A fairly *long needle is boldly thrust into the tender spot The piston is withdrawn* to prevent injection into a vessel If blood does not appear in the barrel 5 to 10 cc of the local anesthetic are deposited in the tender points This procedure may produce or aggravate the radiating pain that passes down the extremity Should this occur the patient may be assured that the dis comfort indicates the probable success of the injection

After the injection of the tender points an additional amount of the solution is deposited in each of several spots within a radius of ½ inch Often it will be necessary to insert the needle sufficiently deep to strike on the periosteum of the ilium before complete relief is obtained

Finally as the needle is withdrawn 1 or 2 cc of solution are deposited in the fascial planes Even though the patient notes immediate relief of symptoms the postinjection treatment should include strapping rest and the application of heat

Strapping—Whether or not the patient is relieved by manipulation or procaine injection *the back should be strapped* with adhesive tape to re

Those which are designed to immobilize the back are best reenforced posteriorly with several strips of light metal The low lumbo sacral or sacro iliac belt or corset affords a grateful feeling of support around the lower back region Actually the amount of immobilization obtained by this appliance is almost negligible When used in conjunction with a belt or a canvas strap around the corset this encircling band is most advantageously placed between the levels of the greater trochanters and the iliac crests

Medication—During the acute periods it may be necessary to give the patient an injection of an opiate such as *codeine* 1 grain or *demerol* 50 mg (⅝ grain) If possible however these preparations are avoided since they will lead to difficulties with the bowel and straining incidental to oostipation tends to produce a recurrence of the back pain Salicylates coal tar products and hypnotics may be used more liberally Often the patient finds comfort from a capsule containing 3 grains of acetylsalicylic acid 3 grains of acetophenetidin 3 grains of bicarbonate of soda and ¼ grain of codeine phosphate

Subsequent Treatment—The patient who has suffered an acute low back strain is most carefully examined as soon as the symptoms are relieved and the strapping can be removed The procaine injections may be repeated if need be If the skin is irritated the patient is ordered to purchase a sacro iliac support and as soon as is possible a *radiographic examination* is made the *neurologic findings* are reviewed and an orthopedic specialist consulted if anything unusual is revealed in the investigation

CHRONIC POSTURAL BACK STRAIN (CHRONIC STATIC BACK STRAIN)

The chronic back strains are usually preceded by elements of acute trauma Less often there is an insidious onset of pain in the lower back most often localized to the lumbosacral junction The lumbago comes on after the patient has been standing or walking for several hours and is usually worse at the end of the day Obese middle aged persons with protuberant abdomens and poor postures are particularly prone to develop this type of symptom They complain of a dragging and aching pain in the lower back when they are tired The pains are usually worse too in the morning after the patient has been sleeping in a soft bed with a sagging mattress After a few minutes the pain works out and the patient may be relatively comfortable until fatigue sets in later in the day

A variation of the chronic postural back strain occurs in the upper regions between the shoulders There is involvement of the paravertebral musculature in the dorsal region The pain is *interscapular* and is noted as a chronic ache in patients who have poor posture or whose occupations keep them bent over a desk for long periods of time

The examination of patients with chronic postural back strains reveals the usual findings with *faulty posture* (p 3055) There is an exaggeration of the anteroposterior curve of the spinal columns The abdomen is protuberant The chest is sunken and the musculature is flabby and relaxed Motions of the low back are generally restricted but the spasm that features the acute strains is not noted The straight leg raising test may be mildly positive Tenderness is usually present over the lumbosacral joint

neck of the lifter If he is to arise from the right side of the bed (with reference to his own recumbency) he places his left arm around the neck of the attendant who stands on his right When the patient gets to his feet, he is urged to take small steps but must stand straight If he sits up a firm chair with side arms is used and the patient is instructed to sit well back and keep both feet flat on the floor When the patient returns to bed he resumes the position previously described

Back Braces—The most rigid and effectual form of support for relief of strain on the low back is absolute bed rest on fracture boards or in a plaster spica The most effectual form of support for the ambulatory patient is a jacket made of plaster of paris or caster The latter is a water proof light and moderately flexible material resembling celluloid It is obtainable in sealed cans and may be applied exactly as is plaster except that it does not need preliminary wetting with water since the bandages

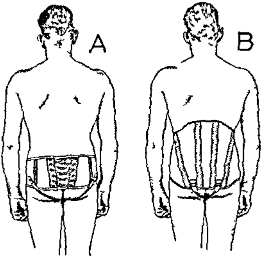


Fig 869—*A* Sacro iliac belt *B* Lumbosacral support These are constructed of heavy canvas with stays of spring steel *

are dissolved in an acetone base Either type of jacket may be bivalved and fitted with buckles or laces to provide a removal type of back support

Next in order of efficiency or effectiveness is the *spinal brace* The *Knight spinal brace* consists of four upright metal bars (two on each side of the midline posteriorly and two in each axillary line) and two transverse metal bars connecting the ends of the uprights The lower transverse bar should be fitted posteriorly to rest at a level between the greater trochanters and the iliac crests The upper transverse bar may be at various levels depending upon the level of the spine to be immobilized The front part of the body (abdomen and chest) is covered by a canvas apron which may be laced together firmly fastening the brace The metal bars themselves are generally covered with leather The *Taylor brace* does not have the lateral upright irons and is considerably lighter

Corsets—Corsets are of various types They are used when a brace would be too rigid or bulky but they afford considerably less support

* Shands, Handbook of Orthopaedic Surgery C V Mosby Company

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DIFFERENTIAL DIAGNOSIS OF

Low Back Pain (Lumbago)

Low back pain may be caused by any of the factors responsible for discomfort in the cervical (p 2818) and thoracolumbar regions (p 2274) Additionally this common complaint may result from abnormalities involving sacroiliac region lower lumbar vertebrae coccyx and the contents of the pelvis

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES

Gynecologic

Physiologic	Dysmenorrhea (p 2561) Onset of labor (p 2697)
Uterine	Retropositioning of uterus (p 2537) Endometritis with purulent discharge (p 2607) Endometriosis with uterine fixation, dysmenorrhea and chocolate cysts (p 2558) But look for additional causes particularly mechanical
Pelvic Peritoneal	With diffuse infection or abscess Check temperature curve and sedimentation rate (p 2604)

Male Reproductive

Prostatic	Acute and chronic infections Consider gonorrheal tuberculous and non specific etiology Massage by rectum and examine urethral discharge (p 2340)
Seminal Vesicular	Same as above

Renal

Congenital Anomalies	Ectopic kidney with hydronephrosis (p 2270)
Infection	Renal carbuncle or perinephric abscess Examine urine Note pyrexia (p 2334) Refer to urologist
Nephropathy	Only in the patent medicine *ads*

Neurogenic

Neurogenic	Tumors of cord and cauda equina. Look for sensory and motor signs (p 1497) Refer to neurosurgeon Herniation of nucleus pulposus with sciatica Do neurologic survey Get laminogram (p 3074) Consider surgery

Spinal

Congenital Anomalies	Hemivertebra sacralization of L V spina bifida transitional vertebrae tropism, spondylolisthesis kyphosis scoliosis and lordosis Get AP lateral and lateral oblique x rays recumbent and erect
Neoplastic	Usually metastatic malignancy Look for primary in breast, sto

Metabolic	
Osteo-arthrosis	Metabolic disturbance usually in obese middle aged patients with hypometabolism. Involvement of spine weight bearing and distal interphalangeal joints X rays show narrowed joint spaces lipping and spur formation *Normal temperature and sedimentation rate* No muscle atrophy (p 2856) Institute complete therapeutic routine
Gout	*Metabolic disorder of purine metabolism. Note* high blood uric acid, tophi and sodium urate deposits (p 2867) Try therapeutic test with *colchicine*

Infection and Inflammation

Fibromyositis	Especially of sacro-iliac region Note indurations (p 2894) Relief from injection of trigger areas with procaine
Rheumatoid Arthritis	Inflammatory disturbance usually in ptotic adolescents and young adults Involvement of any and all joints especially spine and proximal interphalangeal Note pyrexia increased sedimentation rate muscle atrophy and vasomotor instability (p 2910) Institute complete therapeutic routine
Osteomyelitis	Pyogenic or tuberculous Get x rays and blood cultures Do tuberculin test (p 2930) Note response to antibiotic treatment

Mechanical Disturbances

Mechanical Disturbances	Acute and chronic back strain relieved by strapping and rest (p 3058) Subluxation of articular facets with acute pain and disability Relieved by manipulation (p 3057) Fracture dislocation. Get AP and lateral x rays Keep *in hyperextension for orthopedic consultation* (p 3009) Herniation of nucleus pulposus as described above

where a rather more acute angulation than is normally expected may be found Tenderness is often noted over the buttocks or the paravertebral lumbar muscles Often there is an associated *fibromyositis* (p 2894) with *trigger points over the sacro iliac* joint *Almost invariably* these patients suffer from *poor foot posture* (p 3078) In the other back strains there is moderately marked tenderness over the lateral musculature The disturbance *may involve the trapezius muscles or the rhomboidei where areas of* induration which are exquisitely tender are noted

Treatment—The treatment of chronic postural back strain follows the lines indicated in the acute disturbances *Manipulations* are less likely to be effective The *procaine injections* give less relief since such localized areas of tenderness are rarely noted *Strapping* is of only temporary efficacy and heat gives only transitory relief

It is imperative that the patients make a serious effort to correct *postural defects (p 3057) and carry out the corrective exercises (p 3757)* A

low calory diet (p 697) is given to those who are obese If the basal metabolic rate is depressed corrective and then maintenance doses of *thyroid extract* (p 1189) are administered Obese women are encouraged to purchase *serviceable shoes* (p 3083) and wear *tight laced corsets* Corpulent men are ordered to purchase a *sacro iliac belt* (p 3070) or an *abdominal binder* *Correct shoeing* is as important in men as in women

The patient is urged to rest in the *corrected position* (p 3069) with the local application of *heat* (p 3787) for as long as is possible without interference with wage earning and household duties There is little or nothing to be gained by incurring extra expense for short wave *diathermy* or any other type of electrotherapy *Massage* is often grateful if the patient can afford it Bed boards or a hard mattress are required to afford support at night

If these simple measures of therapy are not successful the patient should be referred to the orthopedic specialist who will often fit a *Knight spinal brace* (p 3070)

HERNIATION OR PROLAPSE OF THE NUCLEUS PULPOSUS (RUPTURE OF THE INTERVERTEBRAL DISK)

The nucleus pulposus is an elastic jelly like cushion which is interposed between the bodies of the vertebrae It is surrounded by an annular ligament which is weak in its posterior aspect Any sudden strain such as acute flexion or extension of the body while lifting heavy objects and degenerative processes may cause this ligament to rupture posteriorly permitting the nucleus pulposus to extrude into the spinal canal The protrusion is usually to one side or another of the median line and causes pressure symptoms as the result of impingement upon nerve roots

Extravertebral protrusion rarely produces clinical signs or symptoms but extrusion into the spinal canal usually is followed at the time of trauma or weeks or months later by definite signs and symptoms The latter depend upon the level of the lesion The most common location is between L V and S I next in frequency are disturbances of the disk between L IV and L V Anterior protrusion of the disk is likely to produce motor segmental signs and symptoms simulating cord tumor (p 1430) Lateral protrusion may result in a partial Brown Sequard reaction pattern (p 1433) Posterior protrusion which is most frequent commonly results in the production of sciatica

Clinical Manifestations—The acute symptoms that follow prolapse of the nucleus pulposus may be identical with those of an acute low back sprain There is usually a history of sudden pain in the back often associated with sciatic pains that radiate down one or both lower extremities The back muscles are spastic the leg raising test is positive there is limitation of motion in the low back and diminution or absence of knee and ankle jerks Protrusions involving a higher level as for example between L I and L II may produce the signs of conus lesion (p 1433) When the disk is herniated in the lower lumbar regions the cauda equina reaction pattern may be reproduced (p 1434)

The course of the herniation is variable In favorable instances there is spontaneous alleviation of discomfort Again the syndrome may be improved as the result of manipulation (p 3064) T

persistent protrusions result in continued pain atrophy and weakness of the muscles of the lateral portion or plantar surface of the foot obliteration of normal lumbar lordosis hypotonia and atrophy of anterior thigh muscles and disturbances of function of bladder and rectum Quite characteristically the patient notices intensification of pain when intraspinal pressure is increased by cough sneeze or straining at stool



Fig 870 —X ray taken of an injection of lipiodol into the subarachnoid space A definite filling defect demonstrated between the fourth and fifth lumbar vertebrae Note that the intervertebral space is narrowed Man of forty six suffering from severe left sciatica Pain radiated down the posterior thigh posterolateral calf to the lateral border of the foot and was completely relieved after removal of the ruptured intervertebral disk which was pressing on the left fourth lumbar root The lesion was at the level of the filling defect shown in the illustration above

Diagnosis —The differential diagnosis of low back pain is elsewhere discussed (p 3072) Suggestive of herniation of the nucleus is the presence of sciatic pain diminution or absence of knee jerk and ankle jerk persistence of symptoms despite strapping procaine injection and manipulation and later demonstrable muscle atrophy

A positive diagnosis is accomplished only through contrast roentgenography after intra spinal instillation of pantopaque Characteristic deformities are depicted under which circumstance surgical therapy is clearly indicated Presumptive evidence of herniation of the disk is afforded by an increase in the protein content of the spinal fluid beyond 50 to 60 mg per cent

Treatment—Conservative treatment is justified with prolapse of the nucleus pulposus provided that the pain can be controlled and that recurrences are not observed at short intervals and with great frequency In the acute episode absolute bed rest is indicated combined with traction to the lower extremity Manipulation may be tried with great gentleness strapping is employed once the acute symptoms have been alleviated Later the patient is fitted with a spinal brace and urged to carry out corrective exercises to reduce lumbar lordosis obese individuals are given a reduction diet those with demonstrable diminution of the basal metabolic rate are given corrective and then maintenance doses of thyroid extract Foot mechanics receive careful attention An attempt is made to correct pronation in the gait efforts are made to teach proper methods of walking (p 3077)

Depending upon the judgment of the physician a variable number of patients come to operative intervention The procedure involves removal of the disk through a comparatively small exposure and fusion of the lumbar spine if indicated When posterior neural arches can be left intact the technical procedure may be a mere removal of the ligamentum flavum If spinal fusion is not required the patient may be up within a short time and may resume normal activities in a few weeks Following fusion immobilization is indicated for a considerably longer period

THE NORMAL FOOT

The normal foot is an organ designed for the functions of *support* and *propulsion* It is composed of a number of bones arranged to form a long arch which runs the length of the foot and transverse tarsal and metatarsal arches

The *long arch* is higher on its inner border and varies greatly in height in different individuals The *long plantar ligament* runs across the base of the arch and acts as a supportive *bowstring* The apex of the arch is supported by the *spring ligament* which directly supports the head of the astragalus The arch is higher in the non weight bearing position but sags to a varying degree when weight is imposed Sagging of the arch is accompanied by a slide of the talus mesially and downward

The *transverse tarsal arch* is supported by criss crossing plantar ligaments The *metatarsal arch* is convex dorsally so that the heads of the three center metatarsals are higher than those of the first and fifth in the non weight bearing attitude When weight is imposed on the foot the arch is obliterated and all metatarsal heads touch the floor More weight is normally borne upon the first and fifth than upon the central metatarsals

Foot Movements—*Dorsiflexion* and *plantar flexion* of the foot take place mainly at the ankle joint *Inversion* and *eversion* of the foot are carried out in the subastragalar talonavicular and calcaneocuboid joints since

the talus is held rigidly in the ankle mortise as far as lateral motion is concerned

The chief *invertor* muscles of the foot are the tibialis posticus and the long flexors of the toes The *evertor* muscles are the long and short pero neals *Dorsiflexion* is produced by the tibialis anticus muscle assisted by the long extensors of the toes *Plantar flexion* is accomplished principally by the calf muscles (gastrocnemius and soleus) which act through the heel cord or Achilles tendon The posterior tibial tendon and the long flexors of the toes also act as a sling to help support the arch

The Normal Gait —Normally the gait is elastic symmetrical and charac terized by a rhythmic alternate flow of *supportive* and *propulsive phases*

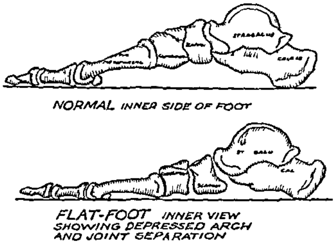


Fig 871 —Normal and flatfoot *



Fig 872 —Heel and toe gait Three phases taken from a rapid photograph of normal walking †

The foot strikes on the heel which is directly in line with the long axis of the foot and is not everted As the superimposed body weight comes over the foot it is borne by the *outer side* of the sole As the body moves for ward on the foot the weight is thrown onto the metatarsal heads and the toes which firmly grasp the ground and by the action of the flexors give a definite push off to the body just before the foot leaves the ground to repeat the cycle During the gait the feet are *parallel* but during the "push off" phase when the *heel has left the ground and the toes and* metatarsal heads are actively pushing the body forward by muscle action there is a definite *supination* of the forefoot This is made necessary by the fact that the metatarsal heads run in an oblique line from the first to the

* Lewin Orthopedic Surgery for Nurses Including Nursing Care
† Hauser Diseases of the Foot

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Clinical Manifestations—The primary symptom of weak foot is *pain* which may be referred to the region of the *long arch* along the inner side over the *spring ligament* or over the attachment of the *long plantar ligament* to the calcaneus The pain is frequently localized behind the *inner malleolus* whence it radiates up along the course of the posterior tibial and long flexor tendons into the *calf* It may be conducted up to *knee hip* and *lower back* The pain is marked after prolonged standing It may also be present at night and is often worse when walking barefoot than when in shoes Pain is accompanied by *fatigability* and there may be *cramps* referred to the calf particularly noted at night

Clinically the weak foot is recognized by the appearance of *eversion* and is best observed from behind The Achilles tendon makes a curve outward to attach to the everted heel The inner border of the foot is convex due to the projecting *astragalar head* which has slid medially off the os

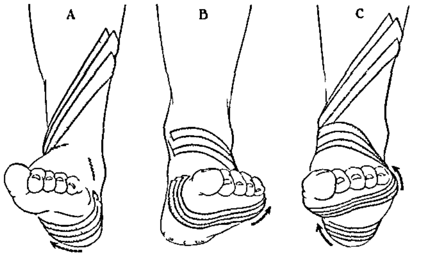


Fig 874—Sketches of foot strapped for foot strain and pes valgoplanus *A* Strapping to bring the heel into varus *B* Strapping to bring the anterior part of the foot into pronation *C* Combination of strappings shown in *A* and *B* to bring the heel into varus and the anterior part of the foot into pronation *

calcis and navicular Viewed from the front an imaginary line dropped *from the patella falls medial to the everted foot This defect in foot posture* is not an irreversible deformity The foot can be placed in proper position by the examiner and may be maintained by the patient s muscular effort Besides being a static deformity the weak foot may be of congenital traumatic or paralytic origin

The *gait* is inelastic and lacks the normal push off The patient shuffles along with the feet in *eversion* A typical weak foot gait is often seen in waiters policemen and others who spend much of their day standing in one place Symptoms are often lacking in those who exhibit the most marked deformities

Physical examination reveals *tenderness* beneath the long arch in the sole of the foot or behind the malleolus along the course of the posterior

* Hauser Diseases of the Foot

shortest fifth and the foot must be supinated if they are all to be kept on the ground

WEAK FOOT (PES VALGOPLANUS FLAT FOOT)

The weak foot presents itself as the flaccid or spastic variety

THE FLACCID WEAK FOOT

Weak foot is an extremely prevalent source of foot pain among city dwellers who walk or stand for long periods on level pavements The muscles which support the arch are those which control *inversion* and *eversion* of the foot They are exercised in traversing rough and uneven ground when the gait is normal In the presence of abnormal gait dictated

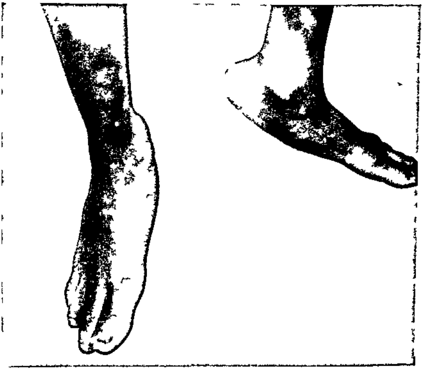


Fig 8/3—Congenital flat feet in adult *

by improper shoes, these muscles become weak and undergo atrophy Under the influence of the superincumbent weight they relax and allow the foot to slip into a poor mechanical posture

The flaccid weak foot is not a structural defect but rather a way of standing The weak foot is usually indistinguishable from the normal foot in the non weight bearing attitude The arch may or may not be of normal height but this is of very little clinical significance When the superincumbent body weight is thrown upon the weak foot the flabby muscles allow the talus to slide downward and medially off the support of the calcaneus

* Courtesy of Louisiana State University Orthopedic Clinic, Charity Hospital in New Orleans

No equinus is permitted A length of 2 inch adhesive about fourteen inches long is started over the outer side of the heel just below the external malleolus It is then carried below the heel and up along the inner side of the calf Similar strips are applied over the first which cross obliquely over the front of the tibia No strips must be laid anterior to the heel for if the forefoot also is turned into varus the patient will walk on the base of the fifth metatarsal and experience pain The vertical strips are held in position by several circular strips of adhesive applied loosely

Arch Supports—There are innumerable arch supports and foot supports One of the oldest and perhaps one of the most effective particularly



Fig 876—Man s shoe

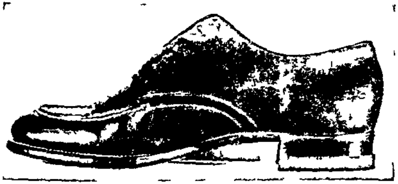


Fig 877—Woman s walking shoe

in young children is the orthodox *Whitman plate* which has a rather high flange on the inner border and another flange on the outer border which grasps the heel to maintain it in inversion However these plates are rather uncomfortable for adults and may have to be replaced by a plate with a lower flange such as the *Shaffer* or *Boston plates* which are flat with very little flange Most plates may be leather covered

Plates are best made from plaster-of paris impressions on the foot taken in a non weight bearing attitude so that the arch is not depressed by the superincumbent weight A plaster slipper is fitted to the foot while the patient is on his abdomen with his knee flexed to a right angle When the plaster is hard the slipper is carefully removed and sent to

* Hauser Diseases of the Foot.

tibial tendon The characteristic deformity has been described and is best estimated by noting the *weight bearing line* There may sometimes be swelling of the ankle or tarsus due to abnormal thrusts upon these joints It is extremely important to determine the range of motion in the tarsal joints in order to distinguish the flaccid and *rigid* varieties of weak foot There is often a restriction of dorsiflexion due to a tight heel cord

Treatment—The treatment of weak foot requires *support* to rest the inflamed and strained *soft tissues and exercises* to rebuild the weakened musculature The foot may be temporarily *supported by strapping* by *arch supports* of various types or by *shoe corrections* Each type of support has its use

Strapping—Weak foot strapping is designed to hold the heel in inversion and restore the line of weight bearing so that the calcaneus is once more *directly beneath the superincumbent* weight This may be accomplished by two technics which will be described in detail For the *Gibney bandage* the foot is brought to a *right angle with the heel* in slight varus

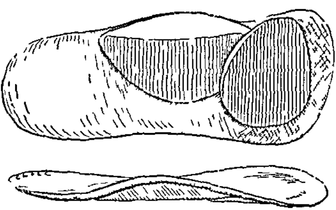


Fig 875—Arch support showing the inclined plane directed laterally under the longitudinal arch and the inclined plane directed medially in the region of the transverse arch

The patient sits at the end of the table and a 2 inch gauze bandage is passed around the anterior portion of the foot The ends of the bandage are given to the patient who is entrusted with the task of maintaining the foot in this position The strapping is then applied by the operator using ½ inch adhesive plaster The first *longitudinal strip* is started at the posterior part of the outer side of the leg about 6 inches above the lateral malleolus It is brought down under the heel and passes up to the corresponding level on the medial side The posterior surface of the heel is then protected with a double layer of sheet wadding and the first of the *transverse strips* of adhesive is started at the base of the little toe It runs over the longitudinal strip and the sheet wadding that has been placed at the back of the heel and ends near the head of the great toe Overlapping longitudinal and transverse strips are then added alternately until the former leaves only a bare area of about 1 inch on the anterior surface of the skin and the transverse strips reach up well above the ankle joint

After preliminary shaving the foot is held in inversion by the patient

* Hauser Diseases of the Foot

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— Hauser Diseases of the Foot

the brace shop as a model If metatarsalgia is present, an elevation may be incorporated behind the metatarsal head

Shoes—Shoe corrections may be used instead of arch supports and are more satisfactory and comfortable especially in the older patient Their only disadvantage is the fact that they have to be attached separately to each pair of shoes and in the case of Denver heels or metatarsal bars



Fig 8 8—Woman s street shoe *

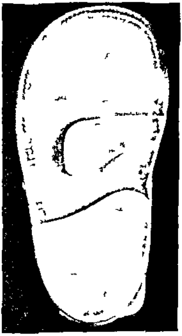


Fig 8 9—Corrective shoe for a child plantar aspect Note the shape and position of the bar *

have to be replaced as they wear down They are described elsewhere (p 3084)

Shoes for children are generally quite satisfactory It is important to make sure that the child does not walk in soft soled baby shoes but rather is fitted with shoes with firm leather soles when he begins to walk The

* Hauser Diseases of the Foot.

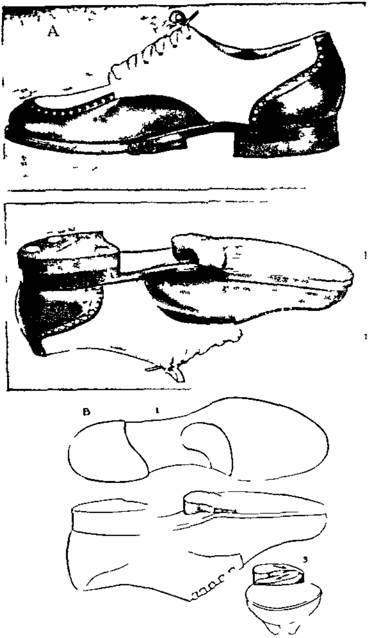


Fig 880.—*A* Photographs of corrective shoe for adolescent girl *B* Sketches to illustrate the Hauser bar 1 Plantar aspect, showing the shape of the bar and its relationship to the heel 2 and 3 Pictures in linear perspective to show the relationship of the inclined plane of the heel to the inclined plane of the bar

shoes should have a snug heel a straight inner border and ample room for the toes There should be at least ½ inch of space between the tip of the

Hauser Diseases of the Foot.

longest toe and the end of the shoe These shoes should have a $\frac{1}{8}$ to $\frac{3}{16}$ inch inner heel wedge to corerct the valgus deformity in weak foot In addition cookies may be added Metatarsalgia is rare in children and



Fig. 881 —Man s correctı e shoe shov ing the advanced heel which is raised on the inner side and the comma shaped transverse bar which is raised on the outer side Note the relationship between the heel and the bar The medial aspect shows the heavy sole and the inclined plane of the transverse bar *

corrections are seldom needed In older and more cooperative children plaster impressions may be taken for arch supports

Shoes for the adult are chosen with similar care and they include the same type of correction *For the man* a *sole* $\frac{5}{16}$ inch in thickness is recom

* Hauser Diseases of the Foot

mended The *heel* measures approximately 1 or 1½ inches and it may have an insert of metal on the outer posterior corner to save wear If *rubber heels* are available they are to be preferred The *shank* should be broad and contain some very light metal The *inner line* of the sole is straight and the anterior part of the shoe should permit free movement of the toes The leather must fit smoothly in the tarsal area *Low shoes* are to be preferred and *calf leather* is the best A *wedge* ⅛ to ¼ inch thick is placed beneath the *inner border* of the breast of the heel and an *anterior arch* is added behind the heads of the metatarsal bones if metatarsal symptoms are present A leather or sponge rubber cookie may be glued into the shoe beneath the medial portion of the long arch

The problem of the *woman s shoe* is more difficult since it is necessary to have different shoes for different occasions The *walking shoe* should have a sole of ¼ inch thickness with a 1¾ inch heel The inner border is straight and the toe is slightly raised The leather under the arch has a steel support The corrections available for these shoes include a *lift* on the *inner border* and an external metatarsal bar or an inside cookie The foot wardrobe of the woman is completed by a *sport shoe* with 1 inch heel and a *dancing pump* with a 2½ inch heel

Exercises —The use of support is only half the battle in the treatment of weak foot Exercise to restore the weakened muscles is equally important and the *best* exercise is the *proper walk* The patient is instructed in this technic by watching his gait in a mirror Additionally he is given the several exercises (p 3760) designed to strengthen the invertors of the foot and the long flexors of the toes and to stretch the shortened heel cord (p 3091)

CONGENITAL WEAK FOOT (CONGENITAL PES PLANUS CONGENITAL VALGUS FOOT)

Congenital weak foot is noted at birth It is usually quite severe and persists in the non weight bearing attitude

The *treatment* of congenital flat foot is modified by the fact that an accurate impression for Whitman plates cannot be taken in a struggling child Until the child reaches the age of cooperation a *wedge* is placed on the inner portions of the heel and *supports* (cookies) are put in the *shoes* (p 3084)

Operative treatment is rarely indicated for the control of flat feet If marked deformity and pain persist despite adequate conservative therapy an *arthrodesis* is performed at the tarsal joint to maintain the foot in corrected position while healing takes place The indications and the operation are the province of the orthopedist specialist

SPASTIC OR RIGID WEAK FOOT

Untreated flexible or flaccid weak foot may progress to the development of *spasm of the peroneal muscles* which maintain a position of deformity The use of the foot in this deformed position tends to create rigidity in the tarsal joints with *fibrositis* (p 2894) of the joint capsules and *fixed contractures* of the intrinsic muscles of the foot The afflicted patient develops an extremely *awkward gait* considerable *pain* and *deformity* This condition may be so severe that it is not correctible by

manual efforts of the examiner When this state persists over a long period of time an *osteo arthrosis* (p 2855) of the tarsal joints develops

Treatment is the province of the orthopedist specialist who achieves correction by repeated stretching or wedging or by manipulations under anesthesia The correction is maintained in a plaster of paris cast for several weeks following which the foot is altered to a flexible weak foot and is treated as such (p 3080) If permanent damage has been done to the subtalar joint a *fusion operation* may be necessary

MORTON S METATARSALGIA

Metatarsalgia or pain in the region of the anterior transverse arch of the foot is an extremely common affliction, particularly in women Normally the transverse arch is obliterated during weight bearing although

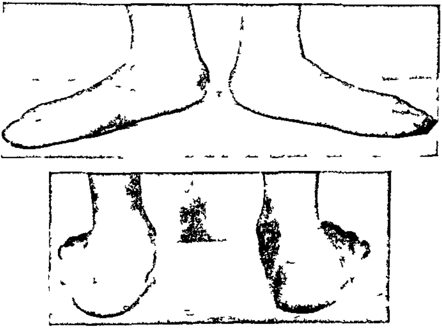


Fig 882—Adult pes valgoplanus *

the major portion of the superincumbent weight falls upon first and fifth metatarsal heads When this distribution is changed so that second third and fourth heads are subjected to a weight bearing strain for which they are ill adapted severe aching pain is noted in the region of the metatarso phalangeal joints The pain most frequently felt beneath the center of the foot may extend to any of the three central toes as a result of neuritic radiation from pressure on the digital nerve by the metatarsal head (Morton s toe) The syndrome is more frequent in women because their higher heels tend to throw more weight upon the metatarsal area Predisposing factors include atrophy of the small muscles of the foot and improper gait

In addition to the characteristic symptoms there may be tenderness beneath second third or fourth metatarsal heads There is frequently an

* Hauser Diseases of the Foot.

associated callosity formation beneath the three metatarsal heads and the toes are often dorsally contractured There may be marked pain on lateral compression of the metatarsal heads and in the acute case swelling may be present A short heel cord is often noted The symptoms occur during weight bearing and are relieved when the patient is off her feet Frequently the patient notices that high heels accentuate the symptoms

Treatment —Immediate relief may be afforded by strapping the patient with a metatarsal pad placed behind the metatarsal head The pad made of felt should be ¼ to ½ inch thick It is placed behind but not beneath the metatarsal head so as to relieve pressure on the tender area After the acute symptoms have subsided more lasting relief is afforded by placing a metatarsal pad inside the shoe in a position corresponding to the position of the felt pad or by a shoe correction using a metatarsal bar

An essential part of treatment is correction of contractures of toes and heel cord Toe curling exercises are ordered These include alternate dorsiflexion and plantar flexion movements such as picking up marbles with the toes The disappearance of the callosities may be hastened by nightly application of 10 per cent salicylic acid in collodion

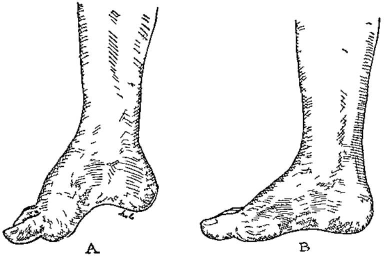


Fig 883 —Pes cavus *A* Before operation *B* after Hoke operation

CLAWFOOT (PES CAVUS HOLLOW FOOT)

The clawfoot is a deformity in which the *longitudinal arch* of the foot is exaggerated in height It is usually associated with a dorsal contracture at the metatarsophalangeal joints Clawfoot may be *congenital* or it may be due to a *muscular imbalance* resulting from neurologic involvement The majority of instances are *idiopathic* and may be associated with a *spina bifida occulta* (p 2820) The deformity is usually slowly progressive

The principal symptoms in clawfoot arise from pressure upon the metatarsal arch The deformity tends to direct the metatarsal heads down

* Lewin The Foot and Ankle Lea & Febiger Publishers

ward against the ground so that they bear excessive weight The result is a *metatarsalgia* (p 3086) which is usually associated with marked *callosity beneath the metatarsal heads* There is frequently an associated *shortening of the Achilles tendon* (p 3091) which further exaggerates the abnormal weight thrust upon the forefoot. The toes are dorsally contractured and cannot be brought down to the normal plantar flexion range

Treatment —Cavus deformity may be relieved by distributing the weight over the entire surface of the foot The patient is provided with an *arch support* which is quite high beneath the long arch so as to throw some of the weight behind the metatarsal heads The shoes are fitted with metatarsal bars More severe cases require a *wedge resection* of the midtarsal joint and plaster immobilization for several months following the operation The dorsal contractures of the toes may have to be corrected if the deformity is severe

HALLUX VALGUS (BUNION)

The primary deformity in hallux valgus is a *varus deviation* of the *first metatarsal shaft* When pointed shoes are worn the big toe is deviated into *valgus* so that a more or less *acute angulation* is produced at the *medial side* of the *first metatarsophalangeal joint* at the site that is subject to pressure Over this angle a *bursa* develops and if pressure is prolonged there is a *periostitis* of the underlying bone with the formation of an *exostosis* The resultant swelling and deformity give rise to the *bunion*

Most bunions can be treated by *correcting the fit of the shoes* using a straight hard inner border which does not deviate the toe into valgus A wide forefoot prevents pressure over the bunion area Correctly fitted shoes are snug over the instep to prevent further widening of the metatarsus The prescription of the proper shoes is accompanied by *passive stretching* of the toe into a corrected position and *active toe exercises* (p 3760) In the more advanced examples where shoes alone cannot correct and relieve the condition a *bunion pouch is improvised by cutting out* a section of the shoe and replacing it by a soft smooth piece of leather

With persistent pain from the bunion or repeated attacks of inflammation *surgical procedures* are required If the principal symptoms result from the exostosis it may be sufficient merely to chip off this redundant bone A *hemiphalangectomy* of the proximal phalanx of the great toe is required in those patients who show a marked valgus deformity with degenerative changes in the first metatarsophalangeal joint

In working people this relatively simple operation must be performed with the greatest skill and care lest permanent stiffness *and impairment* of motion result

HALLUX RIGIDUS

The normal first metatarsophalangeal joint has a range of dorsiflexion of about 60 degrees Degenerative changes may occur in this joint as a result of short shoes improper foot posture and gait There is a resultant *hallux rigidus* or limitation of dorsiflexion Any attempt at dorsiflexion causes marked local pain and the movement is limited by spasm or a bony block which may be visible as an *osteothritic spur* on the roentgenogram

The gait of the patient is markedly altered since the toe cannot be dorsiflexed during the normal push off phase of the gait

The treatment is *hemiphalangectomy* of the proximal half of the proximal phalanx of the big toe If for any reason operation is contraindicated relief of the pain may be afforded by inserting a rigid metal bar between the layers of the sole of the shoe to splint the toe This must run from heel to tip of the toe

HAMMER TOE

A hammer toe is a *flexion contracture* of the proximal interphalangeal joint This results in undue pressure on the tip of the toe which is dug vertically into the sole of the shoe and over the dorsum of the joint



a b

Fig 884 —Hallux valgus in adult

which projects upward against the inside of the shoe It is caused most often by *short shoes* or *short stockings* but it may be congenital in origin

Milder cases are treated by stretching and splinting Well developed cases require surgical correction by the orthopedic specialist

OVERLAPPING TOES

Overlapping toes are usually the result of *improper shoes* though they may be congenital Minor degrees of deformity are corrected by the use of proper shoes in conjunction with stretching exercises and splints More severe degrees of deformity require surgical correction

CORNS (CLAVUS)

Most corns are the result of pressure by improperly fitting shoes Mild cases may be eased by relief of pressure Cases of long standing develop an *exostosis* directly underlying the corn analogous to the condition of

Caldwell in Pullen Medical Diagnosis

the bunion (p 3088) These cases are resistant to conservative therapy and require removal of the exostosis under local anesthesia

PLANTAR WART

Warts which form on the plantar surface of the foot are modified in that they do not project above the surrounding level of the skin and appear usually as localized callosities They are *excruciatingly tender* When the overlying layers of epidermis are carefully trimmed the characteristic central filiform appearance is recognized

Plantar warts are usually treated by curetting the substance of the wart down to the base This procedure is not painful until the base is reached where a minute quantity of trichloracetic acid is applied two or three times at intervals of four days Unusually large or mosaic warts require excision together with the surrounding skin Radiation therapy is highly satisfactory

PAINFUL HEEL

The usual site of pain in the heel is the plantar surface directly in the median line The most frequent cause is a periostitis at the point of insertion of the long plantar ligaments as a result of undue strain due to weak foot Pain usually is relieved by treatment of the primary condition

Chronic discomfort, despite treatment of weak foot often yields to injections of procaine made directly into the tender spot These may be repeated at intervals of several days A felt heel pad is fixed into the shoe The central portion of the pad is cut out over the painful area to relieve pressure during weight bearing Persistent pain may require stripping of the periosteum of the heel

Pain in the posterior part of the heel at the point of insertion of the Achilles tendon is caused by bursitis which may be subcutaneous due to improperly fitting shoes or it may be deep to the tendon at the junction with its insertion The subcutaneous bursa requires rest and relief of weight bearing by the use of a properly fitted shoe A felt pad may be inserted along the counter with a cutout portion directly over the bursa In the variety which is deep to the Achilles tendon the strain on the tendon is temporarily relieved by increasing heel height and limiting activity Injection of the bursa with procaine may be necessary (p 2814)

A rare type of heel pain is due to diffuse periostitis The pain is referred to the lateral portion of the heel and the plantar surface There is tenderness and perhaps deep swelling over the lateral surface of the heel X rays may reveal thickening of the heel in the axial view The etiology of this condition is often obscure Treatment is symptomatic

Heel spurs are projections of bone arising from the inferior surface of the calcaneus They may be palpable or may be disclosed only on *x* ray examination They may be asymptomatic but often they cause localized pain on pressure directly over their location They represent a chronic periostitis usually due to a pull of a strained long plantar ligament They are not usually due to gonorrhea In addition to measures to relieve the accompanying weak foot the pressure of the spur may be relieved by placing a felt pad in the heel of the shoe with a hole cut out in the center to relieve pressure or by scooping out a small pocket in the heel

which is filled with sponge rubber so as to afford a resting place for the spur If all else fails surgical excision may be necessary

SHORT HEEL CORD (CONTRACTURE OF THE ACHILLES TENDON)

Under normal conditions the ankle joint is capable of dorsiflexion with the knee completely extended to a point several degrees beyond the right angle Any lesser range of motion is abnormal and is generally due to a shortness of the heel cord This is confirmed if the range of motion becomes more free when the knee is flexed thus relaxing the gastrocnemius

The principal symptom of short heel cord is *metatarsalgia* (p 3086) though the patient may also complain of fatigue There is usually a feeling of stretching of the calf which is relieved when high heeled shoes are worn and made worse when the patient wears slippers or walks barefoot The pain may be referred as high up as the *low back* (p 3072) Weak foot (p 3078) is a frequent result of the short heel cord since the patient must put his foot into valgus in the attempt to get his heels on the floor

Contracture of the Achilles tendon may be due to *congenital influences* such as *clubfoot* (p 2831) and to paralysis as in *poliomyelitis* (p 457) but the great majority of these deformities result from the prolonged wearing of high heeled shoes and are almost always associated with tightness of the hamstrings

The milder examples of short heel cord are treated by gradual and progressive *stretching* This may be carried out manually by the surgeon by a mechanical device called the Shaffer Boot or by stretching exercises The patient should *not* put on low heeled shoes until the tendons are stretched sufficiently to accommodate themselves to this position The more severe shortenings require operative lengthening of the tendon

HERNIA

The hernia is a *defect* in the *musculofascial wall* of a body cavity Through it the normal contents of that cavity may protrude The important surgical hernias are those of the peritoneal cavity with defects of *congenital* or *acquired* origin involving the *abdominal wall* or the *diaphragm* In these disturbances the parietal peritoneum that underlies the defect stretches and expands to form the *hernial sac*

The Varieties of Hernia —The varieties of hernia in the order of their frequency occur in the inguinal incisional umbilical femoral epigastric and para esophageal regions

Inguinal hernias the most frequently encountered may be *indirect* or *direct* The former involves a primary defect at the *internal inguinal ring* A portion of the abdominal contents may protrude through the hernial orifice then through the inguinal canal the external inguinal ring and into the scrotum Indirect hernias are most frequent in young individuals and most often are due to congenital failure of closure of the processus vaginalis at the internal inguinal ring The sac may not appear until later in life after intestinal content has gradually dilated the original defect

The *direct inguinal hernia* protrudes through a weak point in the conjoined tendon directly beneath the *external inguinal ring* These hernias appear mostly in elderly individuals and present a diffuse bulge which does not usually descend into the scrotum

Incisional hernias protrude through a weakness or a defect in the *scar of an abdominal* incision They may involve a small portion of the cut or its entire length

DIFFERENTIAL DIAGNOSIS OF

Inguinal Swellings and Tumors

The normal adult presents palpable inguinal lymph nodes which sometimes are as large as an almond. Increase in the size of these normal structures asymmetry or new masses require investigation

CLINICAL MANIFESTATIONS AND DIAGNOSTIC FEATURES	
Inguinal Adenitis (Bubo)	Secondary to demonstrable toe foot and leg infections Tuberculous often with cold abscess Look for acid fast lesions elsewhere Get biopsy (p 252) Primary and secondary syphilis Get darkfield microscopy of local lesion or a pirate g and Wassermann may be negative (p 45) Lymphopathia venereum. Positive Frei test (p 473) Chancroid Demonstrate H ducreyii but get darkfield microscopy (p 288) Granuloma inguinale With ulceration and demonstrable Donovan bodies in local smears (p 475) Bubonic plague in epidemics Isolate P pestis by aspiration (p 321) Filariasis in endemic areas Search for microfilaria in blood mears (p 3321)
Neoplastic Lymphadenopathy	Usually metastatic Look for primary in pelvis Get biopsy
Hematopoietic Lymphadenopathy	Leukemias lymphoblastoma and Hodgkin s disease Get hemogram and marrow smears (p 1043) Biopsy if inconclusive
Testicular	Normal inflamed or neoplastic undescended testis Note absence from scrotum. Advise excision.
Spermatic	Inflammations cysts hydrocele and tumors of permatic cord Advise excision if persistent and indolent. Get biopsy
Gynecologic	Hydrocele of canal of Nuck (p 2529) Advi e exploration
Hernia	Inguinal or femoral Note impulsion on cough May be reducible irreducible or strangulated AVOID aspiration Consider surgery if persistent.
Suppuration	Dissecting Pott s abscess (p 2942) AVOID aspiration Get spine x ray
Skeletal	Head of femur in forward dislocation Confirm by x ray
Vascular	Arterial or arteriovenous aneurysm. Note pulsation

Umbilical hernias are almost universally observed in infants and are common in women The primary defect is an incomplete closure of the umbilical ring

Femoral hernias are most common in women The protrusion takes place through the fat pad which lies mesial to the femoral vein It extends alongside of the vessel to the subcutaneous tissue of the upper thigh just beneath the inguinal ligament

Epigastric hernias occur midway between the xiphoid and the umbilicus When small and irreducible they produce misleading symptoms suggesting *peptic ulcer* (p 1780) and *angina pectoris* (p 890) They are best demonstrated by having the patient tense the abdominal wall while the examining finger explores the region

Diaphragmatic hernias are usually para esophageal They are of congenital and rarely traumatic origin and consist of a defect in the diaphragm with protrusion of abdominal content into the thoracic cavity Small defects are frequent chance findings by radiography but misleading symptoms may be produced simulating *coronary occlusion* (p 983) *esophageal obstruction* or *peptic ulcer* (p 1780)

Complications —The simple or *reducible hernia* is one whose content is easily replaced in the abdominal cavity when the patient is recumbent An *irreducible hernia* is one whose content is not replaceable due to a very narrow neck of the sac or the presence of adhesions between the contents and the sac

The *incarcerated hernia* is one containing bowel which is partially or completed obstructed The *strangulated hernia* is incarcerated and additionally there is sufficient interference with blood supply to lead to infarction and gangrene of the involved loop of gut

Diagnosis —The diagnosis of the hernias involving the abdominal wall poses no great difficulty for the practitioner who conducts a careful physical examination The inguinal hernia in the male may escape notice if there is no obvious bulge Under these circumstances the patient is examined while standing erect The external ring is palpated by inserting the finger through the scrotum The patient is directed to cough in order to demonstrate the impulse that is transmitted through the sac The regions of the femoral canal and the internal ring are palpated directly while the patient coughs

Incarceration of gut becomes obvious when reduction cannot be accomplished To effect the latter the patient is placed on his back with knees elevated in order to relax the abdominal wall Gentle pressure is attempted over the hernial sac while the hip joint is passively put through its range of motion in order to find an optimal position favorable to the return of the bowel to the peritoneal cavity Should this procedure fail the patient is placed in a warm tub and the manipulation is gently repeated At times the marked relaxation produced by *spinal anesthesia* (p 3922) successfully reduces the incarceration that fails to yield to simpler forms of therapy

Strangulation of the hernia is suspected when the area becomes tender and there are associated signs of *intestinal obstruction* Sooner or later the patient becomes *febrile* and may develop *shock*

Treatment —The repair of the hernia (*herniorrhaphy*) is a procedure of slight risk so long as the disturbance is uncomplicated An incision is made down to the hernial sac followed by its *excision* and the *repair* of

the defect in the peritoneum muscle and fascia Recurrence is rarely observed unless the patient is obese and the tissues are flabby

The presence of hernial complications increases the risk to life and decreases the possibility of successful repair The *incarcerated hernia* is made

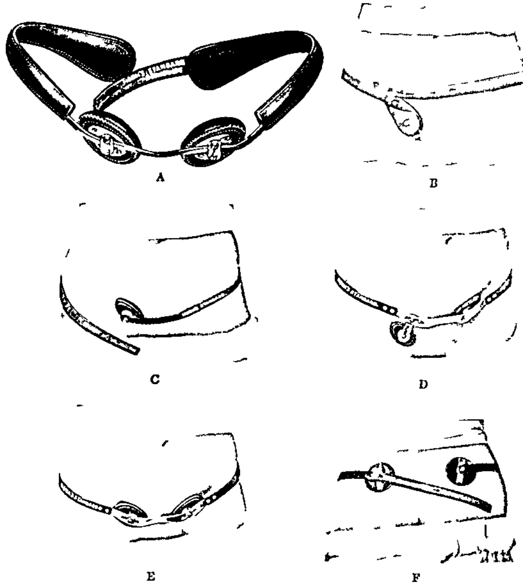


Fig 885—*A* Frame truss *B* Frame truss applied to inguinal hernia *C* Hard rubber truss Crossbody type applied to inguinal hernia *D* Truss applied for femoral hernia on the right side and an inguinal hernia on the left. *E* *F* Double inguinal hard rubber truss applied to double inguinal hernia Front and rear views are shown

hazardous by the accompanying *intestinal obstruction* (p 1873) The patient is dehydrated and toxic and the technical procedure requires that the neck of the sac be incised in order to increase its size sufficiently to permit return of the gut to the cavity provided that the loop is viable

The *strangulated hernia* offers the greatest technical difficulty the highest risk and the least possibility of a successful repair without recurrence The patient is often gravely ill and the operation is undertaken as an emergency procedure If the bowel is infarcted and gangrenous a *resection* is required Contamination of the peritoneal cavity is almost unavoidable and gross soiling may result from perforation although the introduction of powdered *sulfanilamide* (p 88) at the site of the resection has greatly decreased the morbidity and mortality of the strangulated hernia The postoperative course may be stormy due to toxic or obstructive *ileus* (p 1878) and/or *peritonitis* (p 1923)

The *diaphragmatic hernias* require operative correction through a *trans pleural* or *transabdominal approach* The procedure is technically difficult and the risk may approach 10 per cent so that asymptomatic disturbances are best left quite strictly alone In the presence of a small hernia which constricts the neck of the sac a *phrenic nerve section* by paralyzing the diaphragm may eliminate the constriction

Constitutional Factors in Relation to Hernial Repair.—Herniorrhaphy is generally less successful *in elderly patients* because of *senile atrophy* of the muscular and fascial structures as well as the slower rate of healing The procedure is difficult and usually less successful in the *obese* who should be placed on a reduction diet for a considerable period of time before the operative repair is attempted Incisional and umbilical hernias are particularly prone to recur in the corpulent

The less favorable results of hernial repair in older and obese patients and the possibility for the development of hernial complications impel the practitioner to favor herniorrhaphy in the young patient who is other wise in good physical condition In obese elderly or handicapped individ uals the operative risk must be gauged against the degree of the discom fort and the estimated chance for the appearance of complications Thus incarceration and strangulation are least likely to occur if the hernia has a wide neck The occurrence of complications is less dangerous in the stay at home and more to be feared in the patient whose occupation or diversion involves travel

Trusses and Supports—Inguinal and femoral hernias that occur in pa tients who cannot or will not undergo herniorrhaphy require support by means of the truss This requires accurate fitting by an experienced tech nician The physician instructs the patient to apply the truss while re cumbent after assurance that the contents have been reduced The patient is then examined while standing erect and after coughing in order to be certain that the truss accomplishes its best purpose

Abdominal and incisional hernias may require temporary strapping or the use of an abdominal binder or support

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NOTE Boldface indicates colored illustration